UPKAR'S

# AGRICULTURE General Knowledge

Dr. O.P. Rajput

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# AGRICULTURE General Knowledge

(Agricultural Facts/Fundamentals & Objective Type Questions-Answers)

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- Other Agriculture Examinations—Agri-Business, Fertilizers etc.

*By*

*Dr. O. P. Rajput*

D. Sc.

*Revised & Enlarged Edition*

UPKAR PRAKASHAN, AGRA–2

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(An ISO 9001 : 2000 Company)
2/11A, Swadeshi Bima Nagar, AGRA–282 002
**Phone :** 4053333, 2530966, 2531101
**Fax :** (0562) 4053330, 4031570
**E-mail :** care@upkar.in
**Website :** www.upkar.in

**Branch Offices**

4845, Ansari Road,
Daryaganj,
**New Delhi**—110 002
**Phone :** 011–23251844/66

1-8-1/B, R.R. Complex (Near Sundaraiah Park,
Adjacent to Manasa Enclave Gate),
Bagh Lingampally, **Hyderabad**—500 044 (A.P.)
**Phone :** 040–66753330

Pirmohani Chowk,
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ISBN : 978-81-7482-869-9

**Price :** ₹ 95·00
**(Rs. Ninety Five Only)**

**Code No. 884**

**Printed at :** UPKAR PRAKASHAN (Printing Unit) Bye-pass, AGRA

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**Website :** www.upkar.in **E-mail :** care@upkar.in

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# Agriculture
## General Knowledge

# 1 GENERAL
## [Fundamental Agriculture Knowledge]

- India's geographical area—32,87,263 $km^2$; only 2·4% of World surface area of 135·79 million sq. km; provides shelter to nearly 16·7% of human & 14% of cattle of World population.
- India is the '7th' largest country in the world.
- India lies entirely in the northern hemisphere.
- India's mainland extends between latitudes 8°4′ and 37°6′ north; longitudes 68°7′ and 97°25′ east.
- India's length—about 3,214 km (North to South) between extreme latitudes; breadth—about 2,933 km (East to West) between extreme longitudes.
- India's land frontier—about 15,200 km.
- India's total length of coastline of mainland, Lakshadweep Islands and Andaman & Nicobar Islands—7,516·6 km.
- The Plains of the Ganga & the Indus—about 2,400 km long and 240 to 320 km broad; formed by basins of 3 rivers—Indus, Ganga & Brahmaputra.
- North-Eastern (NE) Region is called **'7 Sisters' of India**, including the NE-States—Assam, Arunachal Pradesh, Nagaland, Manipur, Tripura, Mizoram and Meghalaya, later on added **'Sikkim'**. (now total 8 States).
- The Peninsular Plateau (marked–off from plains of Ganga and Indus) by a mass of mountain and hill ranges–460 to 1220 metres in height, represents Aravalli, Vindhya, Satpura, Maikala and Ajanta.
- Desertic area is in two parts–large & small; wherein large deserts–spreading from Rann of Kuchch towards north and upto Luni river; and small desert–between Jesalmer and Jodhpur, starting from Luni river upto north waste-lands. Between these two deserts, waste-lands stony soils and storage of lime, are existed.
- Contribution of Agricultural Research in total productivity growth has been as high as 48%.
- **'Tongya'** means shifting/Jhum/Jhuming cultivation adopted in hilly and tribal areas of Bihar; besides in Myanmar.
- Agriculture, Forestry & Fisheries sector contributing in Total **GDP** was 16·3% (2009-10).
- India has the largest cattle population in the world; *viz*. 57% of total buffalo and about 16% of cows-bullocks of the world. As per 18th Indian Livestock Census (2007) total livestock population was 529 million nos, with an annual (compound) growth rate 5·88%.
- India ranks **first** in respect of buffaloes, **second** in cattle and goats, **third** in sheep and **fifth** in ducks and chickens, tenth in camel population in the world.
- About 19 million people work in livestock sector.
- During 2010-11, milk production in India was 121·8 million tonnes, ranking $I^{st}$ in world.
- The contribution of livestock and fisheries sectors in total GDP during 2009-10 was 4·1%.
- The per capita per day milk availability in India is 281 g (2010-11), as against 286 g world average and minimum requirement is 211 g/day/capita.
- The per capita per day oil availability is 19 g, as against recommended oil 33 g/day/capita by medical scientists.
- As per National Forest Policy, 1988 for ecological balance, the forests-cover should be on 1/3rd area (*i.e*. 33%) of the country, which is only on 20·64% *i.e*., on 6,78,333 sq km area (*i.e*. 12% dense, 8% open, 0·6% mangrooves) to geographical area presently. India's forest (percentage)—1·2% in World & contributes 1·7% in GDP.
- Forest covered by density classes are; 38·3% open forest and 61·7% dense forest in India.
- High Yielding Varieties (HYV's) Programme started in—1966.
- First Agricultural Census in India conducted in—1970 and eighth census in 2003.
- Cattle Insurance Scheme started from—1974.
- 17th Livestock Census in 2003 & 18th Census 2007 were completed.

- Establishment year of various Institutions—
  —1970–Indian Cashew Corporation
  —1971–Indian Tea Trade Corporation
  —1972–Marine Products Export Development Corporation
  —1974–Indian Mica Trade Corporation
  —1986–Agricultural & Processed Food Products Export Development Corporation.
  —1998–National Agriculture Technology Project (NATP) [World Bank Funded]
  —1998–Kisan Credit Card Yojana started
- **First** Origin of India—
  —Hybrid Pigeonpea–ICPH-8 (ICRISAT, Hyderabad)
  —Hybrid Sunflower– BSH–1 (Pro-Agro)
  —Hybrid Cotton–H-4 (Surat Farm, Gujarat)
- During 2003–04, the increase in Agriculture and related sector for value addition was noted 9·1%, as against 1996–97—9·6% the highest obtained.
- India has **Two** hot spots of Bio-diversity (out of 10 in the World). *i.e.*, Western Ghats and North-Eastern Region.
- Contribution of Agricultural Research to total productivity growth in India is 48%.
- India has nearly 8% of total plants and animals of the world.
- ICAR established the National Research Centre on Rapeseed-Mustard (NRCRM) Bharatpur (Raj.) on October 20, 1993 to carry-out basic, strategic and applied research on rapeseed-mustard & now Directorate of Rapeseed-Mustard (DRMR) w.e.f. 1-4-09.
- All India Co-ordinated Research Project on Oilseeds (AICRPO) was established in April, 1967 for the improvement of oilseeds in the country ,with its H.Q. Hyderabad.
- India's Revolution (achieved) in Agriculture Sector & related fields—

| Revolution | Related Sector |
|---|---|
| ● Green Revolution (1966–67) | Foodgrains Production (especially Wheat/Rice) |
| ● White Revolution | Milk Production |
| ● Yellow Revolution | Oilseed Production |
| ● Grey Revolution | Fertilizer Production |
| ● Blue Revolution | Fish Production |
| ● Red Revolution | Meat/Tomato Production |
| ● Round Revolution | Potato Production |
| ● Silver Revolution | Egg Production /Poultry |
| ● Pink Revolution | Prawn Fish Production |
| ● Golden Revolution | Fruit Production (Apple) |
| ● Brown Revolution | Non-Conventional Energy Sources |

- **Green Revolution**—The term **Green Revolution** was first used in 1968 by former **USAID** (United States Agency for International Development-Director William S. Gaud (died in 1977). William S. Gaud—appointed as executive Vice-President in IFC on 1 October 1969.
- **Need of Revolution in Future in India**

| | | |
|---|---|---|
| (i) | Black Revolution | Bio-diesel Production for self sufficiency in Petroleum & Mineral Oil. |
| (ii) | Food— Chain Revolution— | **Mandate** To double the average income of Indian farmers by 2010. |

- India needs a '**New Revolution**'/**Second Green Revolution** to capitalize on the gains provided by the '**Green & White Revolutions**'.
- This New Revolution in the food sector should aim at reducing the wastage of foodgrains, fruits and vegetables worth thousands of crore each year.

(iii) Rainbow (Satrangi *i.e.* **'BIVYGOR'**) Revolution—This can be achieved through taking altogether the above Revolutions in future.

- Father of India's 'Green Revolution' in Agriculture—Dr. M.S. Swaminathan (Monkombu Sakbasivan Swaminathan)—Ex. DG (ICAR) observed this revolution from 1966-67 & continued upto 1976-77 in wheat and rice.
- Nobel Peace Prize (1970) for **'Green Revolution'** awarded to U.S. Scientist Nobel Laureate Dr. N. E., Borlaug (Norman Earnest Borlaug) (only Nobel-Laureate in Agric in the World)—death 12 September, 2009 (95 years age).
- '**White Revolution**' (Milk Production) through '**Operational Flood**' I Step—1970–81, II Step—1981–85 and III Step—1985–96 (completed in April 1996)
- '**Father of White Revolution**'—(Late) Dr. Vergese Kurien (1921-2012) First-Director Chairman, NDDB, Anand (Gujarat) Padma Vibhushan, Magsaysay Award and World Food Prize awarded. (born 26 November, 1921 death 9 September, 2012, 91 years live)
- Chairperson of **'NDDB'** (est. 1965) is now Dr. (Ms) Amrita Patel w.e.f. 1998.

- On March, 1998; Dairy Co-operative Societies–77,531; 9·8 million farmer members & 170 Milk-sheds in the country.
- First Director General (DG) of ICAR—Dr. B.P. Pal (Benjamin Pyare Pal); and presently (in 2010)–S. Ayyappan.
- In India, per capita availability of Agricultural use land—0·30 hectare.
- Per agriculture family—land available–4·5 acre (nearly 1·8 hectare).
- '**AGMARK**'—According to '**Agriculture Production Act–1937**'–**AGMARK** is used as a National Mark to express the quality and purity of Agriculture and Animal products.
- A new scheme '**NAIS**—National Agriculture Insurance Scheme' has been started w.e.f. **Rabi** 1999–2000 in place of CCIS (Comprehensive Crop Insurance Scheme).
- India's population (Census 2011)-1,210,193,422 (Annual growth rate about 1·76%).
- In India, the NPK nutrients ratio, being used in agriculture; in year 2009–10, it was 4·3 : 2·0 : 1, as against the ideal ratio of N : P : K 4 : 2 : 1 in cereals however, it was 9·5 : 3·2 : 1 (at decontrolled on fertilizers) in the year 1992–93.
- '**Loknayak Jai Prakash Narain Nidhi**' (Fund) was declared to formulate on Feb. 2004, which will take the place of existing RIDF (Rural Infra-Structure Development Fund); and has started w.e.f. 17 Feb, 2004 by giving some funds.
- The '**Seed Act–1966**' has been modified into seeds Bill, 2004.
- **Animal Husbandry and Dairying Sector**—(i) Percentage / number in India of the World → 16·5% Cattle, → 56·5% Buffalo, → 17·7% Goat, → 5·5% Sheep and → 2·7% Poultry

  (ii) In India, nearly 10% family engaged in Animal Husbandry and Dairying Sector *i.e.*, one person in each family; say–about 19 million persons employed.

  (iii) Contribution of Animal Husbandry Dairying & Fisheries Sector in G.D.P (Gross Domestic Products)—4·1%; (during 2009-10) with 14·9 million workers engaged in rural area.

  (iv) Women constitute 71% of labour force in livestock farming. In dairying, 75 million women engaged, as against 19 million people.

  (v) India's diversified food consumption basket-non-foodgrain items-milk, meat, egg and fish.
- Causes of pungency/bitterness/colour in Fruits and Vegetables.
- **Causes of pungency/bitterness**

| Symptoms | Causes |
|---|---|
| ● Aonla (Phyllanthus emblica) —(Sourness) | —Tenin/Galic acid/Ilogic acid/polyphenol |
| ● Arbi (Colocasia) —(Acridity/bitterness) | —Calcium Oxalate |
| ● Badam (Almond) —(Bitterness) | —Emyladin |
| ● Bael —(Liquidification) | —Marmelosin |
| ● Bittergourd —(Bitterness) | —Memordicocide |
| ● Chilli —(Pungency) | —Capsaicin |
| —(Red Colour) | —Capcyanthin |
| ● Cucumber —(Bitterness) | —Cucurbitacin |
| ● Carrot —(Yellow colour) | —Anthocyanin |
| —(Orange colour) | —Carotin |
| ● Garlic —(Pungency) | |
| ● Uncrushed | —Allinase, Amino acid |
| ● Crushed | —Alicin |
| ● Fresh | —Alyl radical di-sulphide (smell) |

| | |
|---|---|
| ● Khesari (Lathyrus) | |
| —(Paralysis, Jaundice) | —BOAA (β-Oxalyl di-Amino α) |
| | —Alanine (a neurotoxil compound) β-oxalyl di-Amino Propionic Acid, Neurotoxin, Lathrogen Alkaloid |
| ● Lobia | |
| —(More protein than other pulses) | —Excess due to Mathionin Amino acid |
| ● Mustard Oil | |
| —(Oil pungency) | —Glycoside Singrin ($C_{10}H_6O_9NS_2K$) |
| ● Neem (Azardirachta indica)–(Bitterness) | |
| — Leaf | —Limbin, Nimbinene, Nimbandial |
| — Bark | —Nimbin, Nimbinin, Nimbidin |
| — Kernel (Seed) | —Nimicidine, Azardirachtin compound (India won **Neem Patent** in March 2005, from WR Grace Company of America—since 1999). |
| ● Onion | |
| —(Pungency) | —Allyl Propyle di-sulphide |
| —(Yellow colour) | —Querecitin |
| —(Red colour) | —Anthocynin |
| ● Oilseeds Oil | |
| —(Yellow colour) | —Carotinized (Alyl-Iso-thiocynate) |
| —(Greenish colour) | —Chlorophyll |
| ● Papaya Fruit | |
| —(Yellow colour) | —Carica Xanthin pigment |
| ● Peeper | |
| —(Bitterness) | —Marelosin |
| —(Smell) | —Oleoracin |
| ● Potato tuber | |
| —(Greenish colour) | —Solanin |
| ● Radish | |
| —(Pungency) | —Isocynate |
| ● Turnip | |
| —(Pungency) | —Calcium oxalate |
| ● Tomato-fruit | |
| —(Red Colour) | —Lycopin |
| ● Termeric | |
| —(Yellow colour) | —Curcumin |
| ● Toria Oil | |
| —(Pungency) | —Allyl Iso-thiocynate |
| ● Taramira(Rocket Salad) Oil | |
| —(Pungency) | —Allyl Iso-thiocynate |

● **India's rank in the World production in Agriculture Sector**

| | |
|---|---|
| First | Buffaloes population, Tea, Jute, Mango, Banana, Cashew (40% of World export), Hybrid Cotton, Sesamum *(til)*, Irrigated area (21·5%), Irrigation Efficiency, Milk, Pulse area, Coconut, Spices (18% in World trade), Ginger (65%), Turmeric (76%), Cauliflower, Mica, Total Pulse and Milk Production. |
| Second | Arable lands (11·8%) USA-I, Rice, Wheat (next to China), Fruits, Vegetables (12%; after China), Castor, Cattle, Goats population, Sugarcane, Tobacco (leaves), Milk, Island Fish (Fresh water fish), Groundnut, Onion. |
| Third | Total Cereals, Cotton, Potato production (4th in area & 10th in productivity *i.e.* per hectare yield), Cabbage, Sheep population, Rapeseed–Mustard production, Cotton (lint). |
| Fourth | Fertilizers consumption, Tractors in use, Coarse grains (3·5%), Fish, Rubber (I Malesia having 44% production). |
| Fifth | Egg Production, poultry (chickens) and ducks population. |
| Sixth | Flux (wastes), Camel, total meat. |
| Seventh | Total Area (2·5%), Land Area (2·3%). |
| Eighth | Coffee. |
| Tenth | Camel population |

- **Symptoms/diseases caused due to deficiency of nutrients in plants—**

| Symptoms/diseases | Caused due to/ deficiency of |
|---|---|
| ● Apple | |
| — (Fruit cracking) | Bo |
| — (Bitter pit) | Zn, Ca |
| — (Wither tip) | Cu |
| — (Rough bark and cracking) | Cu |
| ● Aonla (Internal Necrosis) | BO |
| ● Citrus | |
| — (Die back) | Cu |
| — (Little leaf) | Cu |
| ● Cauliflower | |
| — (Whip tail) | MO |
| — (Browning) | MO |
| — (Buttoning) | N |
| ● Grape Fruit | |
| — (Hen & Chicken disorder) | BO |
| ● Maize | |
| — (White bud) | Zn |
| ● Mango | |
| — Little leaf (Mango, Litchi, Cashew) | Zn |
| — (Internal Necrosis)/Black tip | BO |
| — (Leaf Scorch) | Excess of Cl ions in water/or excess of MOP (Muriate of Potash) |
| ● Pearch—(Leaf drop) | Ca |
| ● Pea | |
| — (Marsh disease) | Mn |
| ● Pomegranate—(Fruit cracking) | BO |
| ● Sugarbeet | |
| — (Heart rot) | BO |

| Diseases | Due to |
|---|---|
| ● Cotton (Black arm) | —Due to bacteria |
| ● Groundnut (Tikka) | —Due to fungus |
| ● Maize (Charcol rot) | —Due to fungus (Mecrophomina phaseolli) |
| ● Rice (Queen of Cereals) | |
| — (Khaira) | —Zn |
| — (Blast) | —Due to fungus |
| — (Leaf Brown) | —Due to fungus |
| ● Pearlmillet—(Ergot & Smut) | —Due to fungus |
| ● Sugarcane—(Red rot) | —Due to fungus |
| ● Sorghum—(Poisoning) | —HCN (Hydro Cynic Acid/Prusic Acid/Dhurin/Oxalates) |

(Diseases = Dis + ease say; not easy)

●●●

# 2 AGRICULTURE METEOROLOGY

(**Agriculture =** Ager (field) + Culture (cultivation) —**Greek words**

## *General*

- **'Agriculture Climatology'** is also termed as **'Agricultural Meteorology'/'Climatology'/ 'Observatory Science'**.
- **Meteorology**—Study of active physical events and analytic study of equipments of atmosphere, including forecasts of weather, is called Meteorology.
- **Macro-meteorology**—A successive and entire study of lowest layer of atmosphere in meteorology, is called macro-meteorology.
- **Hyetology**—A scientific study of various events like-rains, hails, fog, mist etc.
- The study of climate is called as **'Climatology'**. [*i.e.,* Klima = Climate + logos = study / discourse/Knowledge] – a Latin word used Ist in 17th Century; Klima can also be expressed; as – slope of the earth for present day latitude.
- The cover of air in sky, that is covered around to earth, is called atmosphere. This is divided into 4 parts *viz*.

  The lower (bottom) portion of atmosphere is said to be the **'Troposphere'**; of which the upper layer is spoken as **'tropopause'**.

  Above the **'Troposphere'**; there exists **'Stratosphere'**; in middle **'Mesophere'** and upper most layer is called as **'Thermosphere'**.
- In atmosphere (on volume basis), there exists Nitrogen–78%, Oxygen–20·9%, Carbon-dioxide–0·03%, Argone–0·934%, Niyan 0·00182%, Helium 0·00052% and other gases 0·000662%.
- At the height of 3500 m and above, the decreased atmospheric pressure causes nausea and agricultural activities cannot be carried out despite the domestification of numerous plants.
- The average state of weather of a particular place is called **'Climate'**, which is long stable for a specified area, *e.g.,* cold/warm climate.
- Shortly changed state of atmosphere is called as **'Weather'**, *e.g.,* rains, temperature, humidity, sunshine etc.
- The **'Science of Earthquake'** is called as **'Seismology'**; wherein **'Seismograph'**—a measuring instrument, is used to measure earthquakes.
- **Metrology**—A Greek word refers to the science or system of weights and measures and that is quite different from the word **'Meteorology'**.
- The account (period) of meteorological related events of many days is spoken as **'season'**. Generally, there are 3 seasons—Rainy **(Kharif)**, Winter **(Rabi)** and Summer; but according to Hindi months, these are 6 in numbers *e.g.*, **Spring**—Mid Feb.—April (Chetra-Baishakh); **Summer**—May-June (Jetth–Ashad); **Rainy**—July-August (Shravan -Bhadon), **Winter / Autumn**—Sept.–Oct. (Ashwin–Kartik); **Hemant** (Mid Winter)—Nov.–Dec. (Agahan–Pous); **Shishir** season (Cold Winter)—Jan.–Feb. (Mah–Phalgun).
- The vapours presented in atmosphere, after cold and condensation, become changed into drops, is called **'Dew'**.
- **'Dew Point'** is the temperature, on which, the amount of present water-vapours in any volume of air, are enough to saturate of similar volume-air.
- Fog is formed, when air masses of high moisture content close to the surface are cooled.
- The vapours in condensation process condensed so much, that will not visible across; is called **'Fog'**, wherein the relative humidity (RH) exceeds to 90%.
- When relative humidity in atmosphere is below 70% and dust particles are dried, called **'Haze'**.
- When relative humidy exceeds to 70% and the temperature of atmosphere just a few

height above the ground during nights of winter (cold) comes down below dew point; and then water vapours become condensed above the present dust particles in air, that causes to invisible atmosphere, called **'Mist'**.

- When rain-drops fall on the ground, after having very cold and converted into ice in the sky, is called as **'Hail'** and also fell fastly in excess amount with air; then it would be said to **'Hail Storm'**; that causes a heavy loss to crops, plant-trees, animals etc.
- In winters, when atmospheric temperature goes down to below 0(zero) degree celsius, and water vapours of air are turned into small particles of ice, before its saturation and these ice particles settle on surface over grasses or land; that is called as **'Frost'**.
- That light and micro drops of water move/ fly/or stable continuously in atmosphere by atmospheric air, is called **'clouds'**.
- **'Cirrus clouds'** are found in sky above the earth or on a very height (8–9 thousand meter), that does not cause to rains.
- The clouds, these are existed at 300 metre height above the earth, are spoken as Rain/Nimbus clouds.
- India is divided into 5 climatic zones, having head quarter at Delhi, Nagpur, Mumbai, Chennai and Kolkata. Further, these climatic zones are divided into 15 Agro-climatic Zones/Region.
- India is divided into 20 Agro-Ecological Zones and further divided into 60 AESR (Agro-Eco Sub Region).
- In India, there are 6 seasons on micro-level; *viz*. Spring, Summer, Rainy, Winter, Hemant and Shishir.
- The crops are divided into 3 parts, according to the weather/season. *viz*. **Kharif**, **Rabi** and **Zaid** crops. **Zaid** means **Zyada** or **Extra** crop other than Kharif & Rabi crops.
- AICRP on Agricultural Meteorology (*i.e*. All India Co-ordinated Research Project on Agril. Meteorology) is at CRIDA, Hyderabad (A.P.)
- AICRP on Improvement of Diaralands is at R.A.U. Sabour (Bhagalpur), Bihar.
- The instruments of observatory are; Evaporimeter – Evaporation; Anemometer – Wind speed; Wind Van – Wind direction indicator; Soil Thermometer – measuring soil temperature; Single Steevension, having 4 thermometers – Dry Bulb Hygrometer and Wet Bulb Hygrometer (Relative Humidity), Minimum and Maximum Thermometer (for temperature of weather) and Double Steevension Screen – Hair Hygrograph (Relative Humidity of 24 hrs.) and Thermograph (self recording temperature of 24 hrs.), ordinary Rain Gauge, Self Recording Rain Gauge and Sunshine Recorder.
- During winters in North India, the rain occurs through North-East Monsoon and during summers, it occurs in North-South India and also in plains of Indus through South-Western monsoon.
- The major elements (components) of weather are; temperature, air-pressure, wind direction, wind speed, rains, humidity and clouds.
- The country is divided into 11 Bio-climatic Regions.
- Roughly, there are 4 seasons in India, *viz*. Winter season (Jan.-Feb.), Summer season (March-May), Rainy season (June-September) and Post-season monsoon (Oct.-Dec.), which occurs in South Islands, that is also called as North-East monsoon.
- The rains usually occur from South-West monsoon in the country.
- In North States of India, winter rains occur from North-East monsoon, whereas in Southern States, it comes through South-Western monsoon.
- Generally, two types of weather winds have influence on climate of India—North–East. Monsoon and South-West monsoon.
- Winter monsoon (North-East monsoon), the winds blow from land to sea, those come-across to Indian ocean, Arabian sea and Way of Bengal.
- **'Forecasting Model'** developed by CPRI (Central Potato Research Institute) campus, Modipuram, Meerut (U.P.) for detection/ prediction of **'late blight'** disease in potato; as—(if, the following conditions exist)—

(1) **Before 7 days** (Position—Non-rainy season) —

(i) Relative Humidity (RH)—85% for 50 hrs.

(ii) Temperature—7·2 – 26·6°C for 105 hrs.

(2) **Before 5 days** (Position–Rainy days/season)

(i) RH—85% and above for 60 hrs.

(ii) Rains—0·1 – 0·5 mm for 2 days

(iii) Temperature—7·2 – 26·6°C for 120 hrs.

### *Meaning in One Sentence*

- **Agro-Ecology**—The study of physical environment, climate and soil in relation to development of agricultural plants and yield related (production amount, quality and capability of seeds-germination), is called **'Agro-Ecology'**.
- **Climate**—The statistical analysis of weather conditions, done/measured at a specified time-interval of a specific area, is called **'Climate'**.
- **Eco-System**—A practical arrangement of nature, that expresses several specialities through inter-activities of biotic and abiotic components in relation to place and time.
- **Heaving**—The effect of low-temperature on plants, is called – **'Heaving'**.
- **Ionosphere**—The upper most layer of atmosphere, which is above the stratosphere.
- **Agro-Climatic Zone**—Classification based scientific management of regional resources so that the growing needs of **'5F'** (food, feed, fodder, fibre and fuel) can be fulfilled without affecting available natural resources and environment.
- **GIS (Geographical Information System)**—It refers to meteorological system based information for rainfall pattern, soil fertility preparing maps farm planning of the area/distts.
- **SRI (System of Rice Intensification)**—A new planting system of rice for enhancing land, water saving (20–25%) & increase crop productivity (20–45%) & also saving labour input (14%), have been demonstrated by the ICAR at farmer's fields.
- **HFT (Horizontal Flushing Technique)**—This new **HFT** technique has been developed for reclamation of saline sodic soils to reduce the gypsum ($CaSO_4$) requirement with regard to soil & water productivity.
- **FIRB (Furrow Irrigation Ridge Raised Bed)**—Method is used in wheat to save 25–40% irrigation water, introduced by PAU, Ludhiana.

## *Multiple Choice Questions*

1. Which is a wrong/false group amongst the followings ?

| | Meteorology Instruments | | Function |
|---|---|---|---|
| (A) | Rain Guage | — | For measuring rains |
| (B) | Wind Van | — | For finding out wind direction |
| (C) | Sunshine Recorder | — | Bright sun-shine hrs per day |
| (D) | Evaporimeter | — | Wind speed |

2. The Head Quarter of Project Co-ordinator—AICRP on Agricultural Meteorology is at—
   (A) Delhi
   (B) CRIDA, Hyderabad
   (C) Kanpur
   (D) Ludhiana
3. In North States (Punjab, Haryana & Western U.P.) of India, Winter rains occur from which monsoon ?
   (A) North - Eastern Monsoon
   (B) South - Western Monsoon
   (C) From both (A) & (B)
   (D) None of these
4. Who is not related to climatology ?
   (A) Kendrew
   (B) Austin
   (C) Critchfield
   (D) Pt. Jawahar Lal Nehru
5. In which climate, the minimum difference in temperature of January and June is found ?
   (A) Tropical (B) Sub-tropical
   (C) Temperature (D) Dry
6. The famous book - **'Meteorologica'** is written by—
   (A) Trewartha (B) J.M. Austin
   (C) Aristotle (D) W.G. Kendrew
7. Match the following—

   **Book**
   (a) An Introduction to Climate
   (b) General Climatology
   (c) India : A Regional Geography (1971)
   (d) Tropical Meteorology (1951)

   **Author**
   1. Trewartha
   2. Kendrew
   3. Dr. R. L. Singh
   4. C. B. Palmer

   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 3 | 1 | 4 |
| (C) | 3 | 4 | 2 | 1 |
| (D) | 1 | 4 | 2 | 3 |

8. Match the following—

**Word**

(a) Agronomy (b) Climate
(c) Horticulture (d) Soil

**Derived from language**

1. Greek word-Klima
2. Greek word - Agro (crops) + nomous (cultivation)
3. Latin word - Hortus (Garden) + coleure or culture (cultivation)
4. Latin word - solum

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 2 | 1 | 3 | 4 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 4 | 1 | 3 | 2 |
| (D) | 2 | 3 | 1 | 4 |

9. Which climate is required for better growth and production of crops ?
(A) Hot-dry (B) Cold-dry
(C) Cold-moist (D) Hot-wet

10. In North India, some times rains take place in winter, which is due to—
(JRF—1997, Physical Science)
(A) Western depression
(B) Monsoon depression
(C) Eastern depression
(D) S–W depression

11. The period on which monsoon is onset in Kerala ? (JRF—1997, Physical Science)
(A) 1-5 May (B) 1-5 July
(C) 1-5 June (D) 1-5 August

12. Match the following invented meteorological apparatus—

**Apparatus**

(a) Thermometer
(b) Rain gauge
(c) Anemometer
(d) Radio-meterio graph

**Scientist**

1. Galileo (1607) 2. Castelli (1939)
3. Leonard the Winsy 4. Molusnof (1930)

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 3 | 1 | 4 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 3 | 4 | 1 | 2 |

13. **'Meteorographia'**, wherein high and low pressure areas are explained; is written by—
(A) Galton (1863) (B) Leumis
(C) Aspi (D) Heidle

14. 'Barometer' is invented by—
(A) Toricelly (1643) (B) Galelio
(C) Sanctorius (D) Casteli

15. Indian Meteorological Department was established for the first time in—
(A) At Shimla in 1875 (B) At Pune in 1928
(C) At Delhi in 1950 (D) None of these

## *Select —True and False*

1. The climate of India is affected by two types (North-Eastern and South-Western monsoon) of seasonal or weather Winds. (…)
2. In Southern States of India, generally the rain occurs through South-Western monsoon. (…)
3. Followings are included in the climate of any place; Intensity and duration of light, temperature, atmospheric conditions *e.g.* humidity and wind velocity, rainfall etc. (…)
4. Solar energy is obtained through electro magnetic waves. (…)
5. The quantity of light is expressed in g cal / $m^2$ / year. (…)
6. The light intensity is measured in candle power. (…)
7. One foot candle is equal to 10·76 Lux. (…)
8. The light intensity at one meter distance from standard candle, is called meter candle or Lux. (…)
9. 'Climatology' word is derived from Klima + logos, which is originated from the Greek word Klima (*i.e.*, Angle of Sun or duration of day and night.) (…)
10. The Indian Meteorological Department was firstly established at Shimla in the year 1875. (…)
11. In Indian Meteorological Department was shifted in the year 1928 from Shimla to Pune. (…)
12. The International Weather or Season Scientific Institute was established at Utrecht in 1878. (…)

## *Fill-up the Blanks*

1. Based on the Agro-Climatic Zones, India is divided into … parts.

2. On the basis of Agro-Ecological Regions, India is divided into … parts.
3. India has … Ecological Zones.
4. **'Twenty'** Agro-Eco Zones (AEZ) of India are further divided into … Agro-Eco-Sub Zone (AESZ or AESR).
5. Fill-up the blanks in the following—

$$\ldots\% = \frac{\text{Saturated vapour on dew point}}{\text{Saturated vapour on certain temperature}} \times 100$$

6. Absolute Humidity = $\frac{\text{Weight of water vapour}}{\ldots\ldots\ldots\ldots}$
7. The speed of …, is measured by the Anemometer.
8. Evaporation is measured by ….
9. The weather forecast in India is made from the city ….
10. The Head Quarter and Research Laboratory of Indian Meteorology is located at … .
11. India is divided into … climatic states, based on rains and temperature by the National Geographic Council in 1971.
12. The height of mercury in barometer at sea level is … .
13. The sudden fall of barometer is the indication of ….
14. Indian Agro-Meteorology Directorate and Laboratory is located at … (Maharashtra).
15. India is divided into … climatic zones.

## ANSWERS

### Multiple Choice Question

| | | | | |
|---|---|---|---|---|
| 1. (D) | 2. (B) | 3. (A) | 4. (D) | 5. (C) |
| 6. (A) | 7. (A) | 8. (A) | 9. (B) | 10. (A) |
| 11. (C) | 12. (A) | 13. (A) | 14. (A) | 15. (A) |

### True/False

All 1 to 12 — True

### Fill-up the blanks

| | |
|---|---|
| 1. Fifteen | 2. Twenty |
| 3. Five | 4. Sixty |
| 5. Relative Humidity (RH) | 6. Volume of air |
| 7. Wind | 8. Evaporimeter |
| 9. Pune (Maharashtra) | 10. Delhi |
| 11. Ten | 12. 76 cm |
| 13. Stomy weather | 14. Pune |
| 15. Five | |

**Websites/Portal/e-Governance Related to Agriculture & Allied Branches**

- **Agriculture & Co-operation Deptt.**
  —DACNET - http : // dacnet.nic.in,
  —AGMARKNET—http : // agmarknet.nic.in
  —DAC—http : // agricoop.nic.in
  —INTRADAC–http : // intradac.nic.in
- ICAR—www.icar.org.in
- **NISAGENET** (National Information System on Agril. Education Net Work in India)—http: ||www.iasrires.in/NISAGENET
- **Deptt. of Fertilizer Deptt**—www.fert.nic.in
- **Environment & Forest Deptt**—http : // env for.nic.in
- **Deptt. of Horticulture**—http : // hertibizindia.nic.in
- **Deptt. of AH, Dairying & Fisheries**—http : // dadf.gov.in
- NAARM (Hyderabad)—http : // naarm.ernet.in
- Food Processing Ministry—http : // www.mofpi.nic.in
- Rural Development Ministry—http : // rural.nic.in
- **'ICAR-Vichar Manch'**—A forum for intellectual engagement on a Variety of issues-Est. in 2007 at ICAR Hq. New Delhi
- Protection of Plant Varieties & Farmer's Right Act, 2001
- **ICAR** Guidelines on Intellectual Property Management & Technology Transfer/Commercialization–w.e.f 2 Oct., 2006
- Right to Information Act (RTI)—2005—for Policy transparency

**Agronomy Societies Established**—
- Indian Society of Agronomy (ISA)—est, in 1955
- American Society of Agronomy (ASA)—est, in 1908

●●●

# 3 AGRONOMY

(**Agronomy =** Agros (crops/soil) + nomas (Cultivation/Management)—**Greek words**

## *General*

- **'Father of India's Green Revolution'**—Dr. M.S. Swaminathan (Dr. Monkombu Sakbasivan Swaminathan), who is Ex-D.G. (ICAR) New Delhi and has also established M.S. Swaminathan Research Foundation, at Chennai (Tamil Nadu).
- A **'Man made cereal'**—**'Triticale'** is the first hybrid cross between wheat *(Triticum aestivum)* × Rye (Secale cereale)
- The first developed hybrids of the country; Sunflower BSH-1 (CMS - 234 F × RHA - 274 M) of Aro-Agro in 1990; and Pigeonpea ICPH - 8 from ICRISAT, Hyderabad.
- The growing of plants in air is called **'Aeroponic'**, whereas **'Hydroponic'** means plants growing in water.
- Days celebrated each year in India /World—
  World Forestry Day — 21 March; World Environmental Day — 5 June,
  World No Tobacco Day — 31 May, World Water Day — 22 March (by UNO).
  World Earth Day—22 April.
  World Population Day — 11 July; World Forestry Day — 21 March,
  National Science Day—28 Feb.
  National Litchi Day — 8 June,
  World Food Day — 16 October; Indian Science Day — 28 February.
  International Labour Day—1 May.
  International Sun Day — 3 May; World Aids Day — 1 Dec.
  —World Watershed/Wetland Day—2 Feb.
  —National Forestry Day—28 July
  —World Coconut Day—2 Sept.
  —International Ozone layer Conservation Day (Theme–Protect Ozone layer, save life on Earth)—16 Sept.
  —Pumpkin Day—29 Sept.
  —Kisan Diwas-23 Dec. (Ch. C. Singh Birthday)
- World Meteorological Day (by WMO—World Meteorological Organization)—23 March.
- Rose Day—25 June.
- **Week or Fortnight Celebrated**
  National Nutrition Week — 1-7 Sept. (Theme — Nutrition Education for All).
  Wild Life Week – 2 – 8 October.
  National Land – Resources Conservation Week – 21 – 27 November.
  Farmers Honour Week
  (Kisan Samman Saptah)— 17–23 December
- India ranks **Second** in the world for wheat production and area; and the (maximum) area under pulse crops in India in the world—ranking - I.
- During 2011-12, the total foodgrains production was recorded (ever highest)—as 257·44 million tonnes in India, which was only 52 million tonnes nearly in 1950-51 *i.e.* a record increase about 5 times.
- Wheat area is nearly 53% of all **Rabi** foodgrain crops. During 2001-02 in the country, the wheat area and production were recorded 25·92 million hectares and 71·81 million tonnes, respectively, whereas in 2002-03, wheat production was recorded 69·32 million tonnes.
- For crop tracking in the country, presently several Institutions are working *e.g.* 'Crop and Weather Watch Group'— Which take care of crop, weather, cost inputs, insect/pests & diseases at the central level; ICAR, Indian Meteorological Department (IMD), Department of Space (DOS)—Through Remote Censing & Sattelite, National Sample Survey Organisation (NSSO), State Agriculture Department, State Agric. Univ. (SAU's) etc.
- The seeds of **'Satyanashi' (Argemone mexicana)** weed, known as **Prickly Poppy** or Mexican popy; mixed with mustard seeds and adulterated its oil with mustard oil, caused a fatal disease *i.e.* dropsy. The oil of prickly poppy has cancer, gangrin disease properties, due to the presence of allyl isothiocynate.

- In mustard oil, to get yellow colour and flavour, butter yellow chemical is mixed, which has cancer properties.
- The per day per capita availability of cereals and pulses is estimated to the tune of 409·9 and 29·4 g, respectively in the year 2007, with a total of 439·3 g of both cereals and pulses, whereas these figures were correspondingly to be 458·7, 35·4 and 494·1g per day per capita in the year 2002.
- For controlling obnoxious weed **Pathenium** Mexican beetle is effective.

### *Meaning in One Sentence*

- **Agronomic Efficiency (AE)**—An additional production through per Kg nutrient, is called AE.
- **Bio-Fertilizer**—The living or latent cell of a strain of micro organism, having capacity to fix atmospheric-N, is called microbial inoculant/or bio-fertilizer.
- **Cardinal temperature**—The optimum, maximum and minimum temperature *i.e.* cardinal temperature, differs/vary from species to species and in different age, also has variability in a specific part or part to part.
- **Ecology**—That branch of Biology, wherein the study of plants and the living-organisms is made and having reciprocal relationship.
- **Eco-system (Ecological system)**—The mutual co-capacity to servive in physical environment of organisms, is called Eco-system.
- **Indicator Plant**—That plant, indicates the deficiency of plant nutrients/or water, *e.g.* [sunflower for water need and maize for plant nutrients].
- **LER (Land Equivalent Ratio)**—It expresses the increased area and profit directly/or indirectly of a intercropping system over sole system. [standard LER value 1·4 & above]
- **LD-50 (LD-Lethal Dose)**—The active ingradient of a mutagen or insecticide having toxicity to cause harm upto 50%, is expressed as LD-50 [lower the rate of chemical, higher the toxicity].
- **Long day plants**—Those plants, which require long photo-period (12-14 hrs) for bloosming; *e.g.* wheat, barley, pea, gram etc.
- **Noxious Weeds**—A legally defined weed, having undesirable, troublesome and difficult to control, characteristics.
- **Nipping**—The topping of crop plants (gram, tobacco, mustard, pigeonpea) to increase more branches/flowering/podding & finally the yield, is called 'Nipping'.
- **Semi - Arid Zone**—The area having annual rainfall between 500-700 mm.
- **Social Forestry**—That system of forestry, which is made for the society and by, through the society, so as to obtain fuel, fodder, fruit and timber wood.
- **Three way cross**—A first pedigree hybrid, which is obtained between single cross and a inbred line.
- **VAM (Vasicular Arbuscular Mycorrhizal)**—A fungi used to increase crop yield through soil inoculation.
- **SRI**—System is adopted in rice cultivation (w.e.f. 1983) developed by French Jesuit-Father Hanri De Laulanie in Madagascar.
- **Relay cropping**—Founder Dr. M.S. Swaminathan (in 1982) in India—continuous cropping system.

## *Major Formulae*

1. **Standard Deviation (S.D.)**—

$$= \sqrt{\frac{2EV}{n}} \times \text{'t' at 5\%.}$$

2. **Benefit/Cost ratio (B/C ratio)**—

$$= \frac{\text{Benefit (Rs/ha)}}{\text{Cost (Rs/ha)}}$$

(B/C ratio means income per rupee spent.)

3. **Aggressivity-Aab**—

$$= \frac{\text{Mixture Yield of 'a'}}{\text{Expected Yield of 'a'}} - \frac{\text{Mixture Yield of 'b'}}{\text{Expected Yield of 'b'}}$$

Aggressivity is a simple measurement, which indicates that if 'a' component is greater, compared to component 'b', then comparative yield increase would be how much ?

4. **Cropping Intensity or Cropping Index (C.I.)**—

$$\text{C.I.}(\%) = \frac{\text{Total Cultivated Area in a year}}{\text{Net Cultivated area}} \times 100$$

5. **Coefficient of Variation (CV%)**—

$$\text{C.V.}(\%) = \frac{\text{S.D.}}{\text{Mean}} \times 100$$

6. **Sodium Absorption Ratio (SAR)**—

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

($Na^{+}$, $Ca^{++}$, $Mg^{++}$ are expressed in m.e. per litre)

7. **Water Use Efficiency (WUE) or Crop Water Use Efficiency ($E_{eu}$)**—

$$E_{eu} = \frac{\text{Crop Yield (Y)}}{\text{Evapo – Transpiration (ET)}}$$

8. **Pore space (%)**—

$$\%\text{Pore Space} = 100 - \frac{\text{Bulk Density}}{\text{Particle Density}} \times 100$$

or, $= 100 - \%$ Solid space

9. **Harvest Index (HI%)**—

$$HI\ (\%) = \frac{\text{Economic Yield}}{\text{Biological Yield}} \times 100$$

10. **Land Equivalent Ratio (LER) or Relative Total Yield (RTY)**—

$$LER = \frac{\text{Yield of base crop in intercropping system}}{\text{Yield of base crop in sole system}} + \frac{\text{Yield of intercrop in intercropping system}}{\text{Yield of intercrop in sole system}}$$

(The standard **LER** value—**1·4** *i.e.* below this value, the intercropping system is not profitable and may be replaced).

11. **Agronomic Efficiency (AE)**—

$$A\,E = \frac{\text{[Yield(kg) of fertilized plot] – [Yield of unfertilized plot (kg)]}}{\text{Amount of fertilizer nutrients supplied (kg)}}$$

(If AE decreases, then, nutrients supply be increased)

12. **Crop Rotation Intensity (CRI) or Rotational Intensity (RI)**—

$$RI = \frac{\text{Number of crops raised in a crop rotation}}{\text{Duration of crop rotation}} \times 100$$

## *Multiple Choice Questions*

1. In the beginning of decade of 1960, the per capita per day total foodgrains availability was 395g, which has raised to the level of … in the year 2010.
   (A) 407 g (B) 399 g
   (C) 395 g (D) None of these
2. The current cereal intake per capita/annum is around—
   (A) 100 kgs (B) 143 kgs
   (C) 50 kgs (D) None of these
3. The per capita net availability per day of milk (g) was … during 2010-11 in the country—
   (A) 281 (B) 200
   (C) 210 (D) None of these
4. The per capita per day net availability of pulses in the country was … in 2010.
   (A) 31·6 g (B) 35 g
   (C) 60 g (D) 50 g
5. Dryland Farming means—
   (A) Multiple cropping
   (B) Raising of high yielding varieties of maize, jowar and bajra
   (C) Controlling depleting soil nutrients status and reclaiming of problematic soils
   (D) The cultivation of drought resistant, short duration and high yielding varieties (HYVs), along with soil and water management techniques, including water harvesting
6. **'Jhuming'** means—
   (A) A type of farm machine
   (B) A type of improved seeds
   (C) A conventional method of farming in hilly areas *i.e.* shifting cultivation
   (D) A type of fertilizer
7. Drought Prone Area Programme means—
   (A) Maintaining seed quality
   (B) Development and use of regional food resources
   (C) Conservation development and use of land, water, cattle and human resources, especially in those areas, where dry spell is found for a long period.
   (D) Providing nutrition for a long period in drought affected areas

8. The sub-species of **Oryza sativa** (Rice) species is grown—
   (A) Indica in India
   (B) Japonica in Japan
   (C) Jawanica in Indonesia
   (D) Above all correct
9. Which of the production is included in foodgrains production ?
   (A) Cereal (Rice & Wheat) crops, only
   (B) Pulse crops, only
   (C) Coarse cereal crops, only
   (D) All cereals (Rice & Wheat), pulses and coarse cereal crops
10. The maximum area under hybrid rice in the world, is found in which country ?
   (A) India (B) America
   (C) China (D) Indonesia
11. Central Rice Research Institute (CRRI)-ICAR is located in the state—
   (A) Patna (B) Ludhiana
   (C) Cuttack (D) Kanpur
12. The maximum area under rice in the state—
   (A) Uttar Pradesh (B) Madhya Pradesh
   (C) Punjab (D) Haryana
13. Among the critical stages, the most critical stage of wheat crop for irrigation is—
   (A) CRI–Crown Root Initiation stage
   (B) Tillering stage
   (C) Jointing stage
   (D) Flowering stage
14. The growing of wheat and mustard simultaneously together in rows, is called—
   (A) Multiple cropping (B) Relay cropping
   (C) Mixed cropping (D) Inter cropping
15. Which of the State produces maximum per hectare yield of sugarcane in India ?
   (A) U.P. (B) Bihar
   (C) Punjab (D) Tamil Nadu
16. In which State, the highest sugar recovery from sugarcane is ?
   (A) Punjab (B) Uttar Pradesh
   (C) Maharashtra (D) Haryana
17. Match the following fodder based crop rotation—

   **Rotation**
   (a) Guar – Oat
   (b) Jowar-Berseem - Jowar- Berseem
   (c) Maize-Lucerne-Lucerne (Ratoon)
   (d) Napier grass-continues over years

   **Duration**
   1. 3 years
   2. 1 year
   3. 2 years
   4. perennial

   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 2 | 3 | 1 | 4 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 3 | 1 | 4 | 2 |

18. Which of the following is false ?

| | Crop Stage | Optimum temp.(°C) for growth |
|---|---|---|
| (A) | For germination | — 21 |
| (B) | For growth and development | — 20-25 |
| (C) | From milking to grain maturity | — 14-15 |
| (D) | On growth of plant | — 30-35 |

19. Rice crop requires optimum temperature—
   (A) For entire duration of growth of plants — 21·37°C
   (B) At flowering — 26·5 - 29·5°C
   (C) At maturity — 20-25°C
   (D) All above correct
20. Which is the correct descending order for per hectare yield of crops ?
   (A) Lobia, Napier, Berseem, Lucerne
   (B) Napier, Berseem, Lucerne, Lobia
   (C) Lucerne, Napier, Berseem, Lobia
   (D) Berseem, Lobia, Lucerne, Napier
21. Match the following—

   **Fodder Crops**
   (a) Guinea grass
   (b) Oat
   (c) Bajra(fodder)
   (d) Napier

   **Optimum Sowing Time**
   1. November - December
   2. Mid July to mid August
   3. February and July
   4. June-July

   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 3 | 4 | 1 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 1 | 3 | 4 | 2 |

22. Match the following—

**Book/Statement**

(a) Soil Fertility - Theory & Practices
(b) P - Citrate Soluble
(c) World Food Prize
(d) Nobel Laurate
(e) Water Management
(f) Climate Classification

**Author/Related Scientist**

1. Borlaug, N.E.
2. Koppen
3. Dastane, N.G.
4. Black
5. Kanwar, J.S.
6. Swaminathan, M.S.

**Code :**

| | (a) | (b) | (c) | (d) | (e) | (f) |
|---|---|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 | 5 | 6 |
| (B) | 5 | 4 | 6 | 1 | 3 | 2 |
| (C) | 4 | 1 | 2 | 3 | 5 | 6 |
| (D) | 3 | 2 | 1 | 4 | 5 | 6 |

23. … is the example of **CAM** plant (Century plant).
(A) Pineapple (B) Coconut
(C) Sunflower (D) Watermelon

24. … is the example of associative, non-symbiotic nitrogen fixing organism.
(A) Rhizobium (B) Azorhizobium
(C) Pseudomonas (D) Azospirillum

25. … is the example of stem nodulating legume.
(A) Sesbania rostrata
(B) Crotolaria juncea
(C) Phaseolus trilobus
(D) Cicer arietinum

## *Fill-up the blanks*

1. The Head Quarter of NRC on Agro-Forestry (National Research Centre on Agro-Forestry) is located at ….
2. The NATP on Plant Bio-diversity Programme was started on 16th July in the year ….
3. The new wheat variety **'shreshtha'** was released during 1999 from IARI, New Delhi, with the name HD ….
4. The new maize (corn) varieties —Him-129, VL-42, Pusa Hybrid 1 & 2 and Prakash are found suitable for the production of ….
5. The variety CSH-17 (Early hybrid) of … crop is regarded better for grain production in M.P., Tamil Nadu, Gujarat and Rajasthan.
6. If the LER (Land Equivalent Ratio) is below the Standard LER value …, then that inter-cropping system would not be advantageous.
7. The harvest index (HI-%) in wheat varies from … to ….
8. The test weight of 1000-grains (g) in hybrid maize is found between … to ….
9. The application of herbicide with irrigation water is called ….
10. The plants grow habitually in water and wet (water logged) soils/lands are called ….
11. The soil moisture retention between field capacity and PWP (Permanent Wilting Point) is said to be ….
12. The application of weedicide before planting/ or seed-sowing is called.
13. The application of herbicide after seed sowing but before germination of seeds of crop is said to be ….
14. … deficiency causes disorder **Khaira** in rice crop.
15. … deficiency causes disorders namely; white bud of maize and little leaf of apple.

## *Select —True and False*

1. The variety of barley - Hordeum vulgare - 6 row barley and Hordeum distinction and Hordeum irregular - 2 row barley. (…)
2. Social-forestry has its objectives for the society, by the society and for the mankind of society. (…)
3. National Afforestation and Eco-Development Board (NAEB) was constituted in the year — 1992. (…)
4. Indian council of Forestry Research and Education is located at Dehradun (Uttaranchal) (…)
5. The Wildlife Institute of India is located at Dehradun. (…)
6. India is one of the twelve mega-biodiversity of the world. (…)
7. Botanical Survey of India (BSI) Kolkata (WB) was established in the year 1890 (…)
8. So far, 13 Biosphere Reserves have been set-up in India. (…)

9. In farm-forestry, popular, subabool, lasoda and sahjan trees are considered suitable for row plantation. (…)
10. For Sodic (Alkali) soils, **neem**, **wild babool** (Keekar), **sisam** and **Arjun** trees are considered suitable. (…)
11. **'Jamun' (Syzygium cumini)** tree plantation is considered suitable for water-logged soils. (…)
12. **'Jand' (Prosopis cineria)** tree is planted for energy plantation. (…)
13. The function of xylem in plants is to translocate absorbed soil water and minerals to the different parts of plant, whereas, phloem acts to translocate the synthesis food produced by leaves to different parts of the plant. (…)
14. Chlorophyll pigment in plants is responsible for photosynthesis. (…)
15. Calvin cycle is present in $C_3$ plants and this cycle is absent in $C_4$ plants. (…)
16. The water moleculers/nutrients ions movement/or mass flow in plants is done from higher concentration area to lower concentration area. (…)
17. Rice is a good example of cross-pollinated crop. (…)
18. Sunflower is an indeterminate plant. (…)
19. **'Triticale'** — an artificial genes, is the cross between Indian Wheat and Rye. (…)
20. The sugarcane crop, planted in September-October, takes 18 months duration in South India is called **Adsali** crop. (…)
21. The sugarcane crop, planted in October-November/or in February-March in north India, takes only 10-12 months to harvest, is called **Eksali** (one year) crop. (…)
22. **NMR** (Nuclear Magnetic Resonance) is an apparatus to measure oil content in seeds. (…)
23. The first stable product in $C_4$ plants is oxalo acetic acid and in $C_3$ plant, it is phosphoglyceric acid. (…)
24. **'CRIDA'** (Central Institute for Dryland Agriculture) is located at Hyderabad. (…)
25. **'BARC'** (Bhabha Atomic Research Centre) is located at Mumbai. (…)
26. **'NBPGR'** (National Bureau of Plant Genetic Resources) is located at New Delhi.
27. **'NAARM'** (National Academy of Agricultural Research and Management) is located at Hyderabad. (…)
28. **'CIMMYT'** (Centro International the Measuromento the Maize Trigo) is located at Mexico. (…)
29. **'INDIA - VISION-2020'** is prepared/documented by Planning Commission, Government of India, New Delhi. (…)
30. FAO (Food and Agriculture Organisation) was established in 1945. (…)

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (A) | 2. (B) | 3. (A) | 4. (A) | 5. (D) |
| 6. (C) | 7. (C) | 8. (D) | 9. (D) | 10. (C) |
| 11. (C) | 12. (A) | 13. (A) | 14. (D) | 15. (D) |
| 16. (C) | 17. (A) | 18. (D) | 19. (D) | 20. (B) |
| 21. (C) | 22. (B) | 23. (A) | 24. (C) | 25. (A) |

### Fill-up the blanks

1. Jhansi
2. 1999
3. HD 2687
4. Babicorn
5. Jowar
6. 1·40
7. 38-42%
8. 150-180
9. Post-Emergence
10. Hydroponic
11. Available water
12. Pre-Planting Incorporation (PPI)
13. Pre-Emergence
14. Zn
15. Zn

### True/False

1 to 16 — (T) 17. (F)

18. (F) 19-21. (T)

22. (F) 23-30. (T)

# Distinguishing Characters of Important Indian Wheat Varieties

| S.N. | Variety | Developed at | Released Year | Area of Adoption | Production Condition |
|---|---|---|---|---|---|
| **(A)** | **Triticum aestivum**—(Indian bread wheats) | | | | |
| 1. | HD-2285 | IARI | 1991 | NWPZ/NEPZ | Late, Irrig. |
| 2. | HD-2329 | IARI | 1985 | NPZ | Timely; Irrig. |
| 3. | HD-2428 | IARI | 1998 | NPZ | Timely, Irrig. |
| 4. | Job. 666 | RAU Jobner | 1996 | All Zones | Timely Irrig. |
| 5. | Kalyan Sona | IARI/Pantnagar | 1967 | NWPZ/NEPZ | Timely Irrig. |
| 6. | LOK-1 | Lok Bharati Sansora (Guj.) | 1982 | CZ | Timely-Late, Irrig. Saline Soils |
| 7. | PBW-154 | PAU | 1986 | NPZ | Timely, Irrig. |
| 8. | PBW-226 | PAU | 1988 | NPZ | Late, Irrig. |
| 9. | PBW-343 | PAU | 1994 | NWPZ | Timely, Irrig. |
| 10. | PBW-373 | PAU | 1995 | NWPZ | Late Irrigated |
| 11. | PBW-396 | PAU | 1996 | NWPZ | Timely, rainfed |
| 12. | PBW-596 | PAU | 2009 | CZ | Timely, Irrig. |
| 13. | UP-2338 | Pantnagar | 1995 | NWPZ | Timely, Late, Irrig. |
| 14. | WH-147 | HAU Hisar | 1977 | CZ, Dry Area | Timely, Irrig. |
| 15. | HD-2932 | IARI | 2008 | NWPZ | Timely, Irrig. |
| 16. | Raj-4083 | RAU | 2008 | CSZ | Late Irrigated. |
| **(B)** | **Triticum durum** (Durum Wheats)— | | | | |
| 1. | PBW-34 | PAU | 1985 | NWPZ | Timely, Irrig. |
| 2. | PDW-215 | PAU | 1992 | NWPZ | Timely, Irrig. |
| 3. | Raj. 1555 | RAU Durgapura | 1983 | CZ/NWPZ | Timely, Irrig. |
| 4. | WH-896 | HAU | 1995 | NWPZ | Timely, Irrig. |
| 5. | DBW–17 | IARI | 2008 | CZ | Timely, Rainfed |
| **(C)** | **Triticum dicoccum** (Khapli wheats)— | | | | |
| 1. | DDK-1001 | UAS Dhanwad | 1995 | PZ | Timely, Irrig. |
| 2. | DDK-1006 | UAS Dhanwad | 1998 | PZ | Timely, Irrig. |
| 3. | DDK-1029 | UAS Dhanwad | 2008 | PZ | Timely, Irrig. |
| **(D)** | **Triticale** (Wheat × Rye cross) | | | | |
| 1. | DT-46 | IARI | 1995 | NHZ | Timely, Irrig. |

(NZ—North Zone; NWPZ—North West Plain Zone; **CZ**—Central Zone; NEPZ-North East Plain Zone; **NPZ**—North Plain Zone).

## Some State Newly Release Wheat Varieties

- Dewa (K9107),
- Maghar (K 8027)
- Gaumti (K 9465)
- Halna (K 7903)
- Ujyar (K-9006)
- Indira (K 8962)
- Triveni (K 8020)

## Salinity Resistant Varieties of Wheat

- KRL-1-4
- Raj. 3077
- PBW-65
- KRL-1-9
- J-666
- LOK-1

## Eminent Wheat Scientists of India

- Dr. Albert Howard (1906)—Awarded International Gold Price/Medal on release of NP-4 (New Pusa, IARI) Wheat Variety.
- Dr. B. P. Pal
- Dr. M.V. Rao
- Dr. S. P. Kohli
- Dr. K. C. Mehta
- Dr. Ram Dhan Singh
- Dr. L. S. Negi
- Dr. M. M. Upadhyay
- Dr. H. R. Khan
- Dr. S. Sen
- Dr. G. S. Murthy
- Dr. V. S. Mathur
- Dr. S. M. Sikka
- Dr. K.C. Sharma
- **Dr. N. E. Borlaug**—Father of **"Green Revolution"** in Agriculture, particularly in wheat development (only Nobel-laurate in the World) (death-Oct. 2009, at 95 yrs age)

## Recently Released Chickpea (Gram) Varieties

| States | Varieties |
|---|---|
| **U.P.** | K-850, Pant G-186, Pusa-256, Pusa-372, Vardan, JG-315, Alok, Vishwas, PBG-1, Samrat, Gaurav, Karnal Chana-1, Pusa Gram-4, Radhey.<br>**Kabuli**—Pusa-1003.<br>**State release**—Aurodhi, Sadabahar, Sadbhawana, Pragati, Surya, Udoi, Guj. Gram-4. |
| **Bihar** | Pusa-372, Pusa-256,<br>**Kabuli**—Pusa-1003, L-550.<br>**State release**—RAU-52. |
| **Haryana** | Gaurav, Pusa 329, Pusa-372, Haryana Chana-1, Udai, Karnal Chana-1.<br>**Kabuli**—Chamatkar.<br>**State release**—Gora Hisari. |
| **M.P.** | JG-74, JG-322, Pusa-417, JG-315, JG-218, Vishwas, Radhey, Ujjain-21, Vikas, Vijay<br>**State release**—KAK-2. |
| **Rajasthan** | C-235, Pusa-256, Gaurav, Udai, Pusa-362, Alok; GTH-1.<br>**Kabuli**—ICCC-32, Chamatkar |
| **Punjab** | C-235, Pusa-261, Udai, Samrat, Alkok<br>**State release**—Hare chhole-1. |

## Some Important Rapeseed-Mustard Varieties Released

(Since 1997)

| S.N. | Variety | Year of Release | Recommended for the State | Characteristics |
|---|---|---|---|---|
| **(A)** | **Indian Mustard** *(Brassica juncea)* | | | |
| 1. | Arawali (RN-393) | 1997 | Haryana, Raj. and U.P. | For Sodic and saline soil |
| 2. | Jawahar mustard-1 | 1999 | M.P. | White rust resistant |
| 3. | Narendra Ageti Rai-4 | 1999 | U.P. | Early sowing and white rust resistant. |
| 4. | Urvashi | 1999 | U.P. | Irrigated |
| 5. | Basanti | 2000 | U.P. | Yellow seeded, white rust resistant and alternaria blight tolerant. |
| 6. | Maya (RK-9902) | 2002 | M.P. and U.P. | Irrigated white rust resistant . |
| 7. | YRN-6 | 2005 | U.P., Rajasthan | Irrigated |
| 8. | NRCYS–5 | 2008 | U.P., Rajasthan | Irrigated |
| 9. | NRCHB-506 & DMH-I | 2009 | U.P., Rajasthan | Irrigated, Ist Indian Mustard hybrid |
| 10. | NRCDR-2 (Bharat Sarson-1), NRC HB-101 (Bharat Sarson 2) and NRC HB-506 (Bharat Sarson-3)-renamed and released in 2012 from DRMR Bharatpur for Rajasthan/U.P./Haryana, Irrigated areas. | | | |

**'Sarson' (Mustard)**—Vernacular name derived from Sanskrit Word "Sarshap" *i.e.* oil of mustard (Chandogya Upnishad-1000BC)

| | | | | |
|---|---|---|---|---|
| **(B)** | **Karan Rai** *(Brassica carinata)* | | | |
| 1. | JTC-1 | 2001 | Delhi, Haryana, H.P. and Punjab | Rainfed |
| 2. | Pusa Swarnim (IGC-01) | 2002 | —do— | Irrigated and Rainfed both. |
| **(C)** | **Toria** *(B. rapa var toria)* | | | |
| 1. | Parbati | 2000 | Orissa | Rainfed |
| 2. | Anuradha | 2002 | —do— | —do— |
| **(D)** | **Yellow Sarson** *(B. rapa var. yellow sarson)* | | | |
| 1. | Ragini (MYSL-203) | 2000 | Bihar, Estern U.P., W.B. | Irrigated |
| 2. | NRCYS-5-2 | 2009 | Rajasthan, U.P. | |
| **(E)** | **Gobhi Sarson** *(B. napus)* | | | |
| 1. | Hyola-401 | | Haryana, H.P. and Punjab | Double low (< 0·8% Erucic acid and < 15 micro moles/g defatty seed meal) |
| 2. | TERI. Unnat (R-03) | 2001 | M.P., Raj., U.P. | Low Erucic acid (< 2%) and high oleic acid (59·5%). |
| **(F)** | **Black Mustard** *(B. nigra)* | | | |
| 1. | Surya (LBM-428) | 2002 | AP | Early maturing |

**Important Varieties of Mungbean (Greengram), Urdbean and Pigeonpea**

**(A)** **Mungbean varieties (Resistant to yellow mosaic virus)**
Pant Mung-1, 3 and 4; PDM-54, PDM-139, Narendra Mung-1, ML-131, ML-818, ML-267, ML-337.

**(B)** **Urdbean Varieties (Resistant to yellow mosaic virus)**—
Pant U-19, Pant U-30, UG-218, Uttara, KU-300, WBU-108.

**(C)** **Pigeonpea/Arhar varieties (Resistant to sterility)**—
Bahar, DA-11, Hy-3C, ICPL-87 (Asha) MA-3, BSMR-175, BSMR-736, Amar Narendra Ashar-1. ICPH-2671 (Hybrid newly released by ICRISAT Hyderabad (in 2011).

**Wheat/Barley Crop—Varieties released from 2004 to 2012**

| S.No. | Crop | Varieties |
|---|---|---|
| 1. | Wheat (*T.aestivum*) | **(A) Central Release**—HD—2864, MACS–6145, SKW–196, HD-2733, HD 2894 |
| | (*T.durum*) | —PDW–291, HI—8627., DBW-17, PBW-590, PBW-596, WH-1105, WHD-948 (Duram) |
| | | (B) **State Release**—K-9423 (Unnal-Halna) HD–2851 (Pusa Vishek), WR–542 (Pusa Gold) PBW–509, Raj–6560, Raj–4037, VL–746 (Kailash), HS–342 (Mansarovar), NW–1076, VL–802, Raj 4083 |
| 2. | Barley | (A) **Central Release**—NDB–1173, PL-751 (6-row), RD-2668, RD-2715 |
| | | (B) **State Release**—NBL–4 (Noorbo), NBL–11 (Sindhu), VL–56 |

**New Basmati Rice developed-2009**

**Basmati**—New Rice Variety Pusa-1401 (scented, commercial purpose) developed recently (2009) for U.P. & Central India, better than Basmati, Pusa-1121.

**Proverb-related to crops/animals**

- Camel crop—Jowar (sorghum)
- Vacca—Cow (Latin word)
- Black Plum (Shyam Ber)—Jamun

●●●

# 4 AGRICULTURE CHEMISTRY AND SOIL SCIENCE

## *General*

- India is the largest producer and consumer of fertilizers in the world, ranking at **'Third'** (next after China and U.S.A.), wherein 9·5% production of NPK—fertilizer nutrients and 10·6% consumption is made of the world here.
- One sixth of the world population (about 16·7%) lives in India.
- In India, nearly 1,736 crore tonnes N,P,K plant nutrients are consumed, its cost is around 35,000 crore rupees.
- The per hectare fertilizer—NPK nutrients consumption (during 2010-11) 144·14 kg, at national level, which varied from state to state; like 241·60 kg in Punjab, 57·91 kg in Rajasthan, 209·38 kg in Haryana, 132·10 kg in U.P. and below 5 kg only in Arunachal/ Sikkim/Nagaland say NER etc.
- N, P, K ratio has improved due to various promotions by the Govt. which was 4·3 : 2·0 : 1 N, P, K in 2009-10 and 6·4 : 2·5 : 1 in 2002-03, as against 9·5 : 3·2 : 1 in 1992-93 (at fertilizer decontrolled stage)
- Urea contains 0·5 to 0·8% Biuret (maximum 1%)—$NH_2CONHCONH_2$ and above this limit, it is harmful (burning) to crop; which is added during urea manufacturing in the factory. Generally 2% urea is sprayed on crops.
- The Father of Agriculture Chemistry is known to German Scientist Leibig (1803-1873).
- Thiourea contains 36·8%N, which has toxic effect on some plants.
- Clostridium bacteria acts in absence of air.
- ***Dhaincha*** **(Sesbania rostrata)** plant has stem nodulation upto 1-1·5 m height and can fix 180-210 kg N/hectare in soil after the deposition.
- Azolla is a fern and fix 40-45 kg N/hectare in rice fields.
- Blue Green Algae (BGA) is a micro-vegetation, belonging to thalophyta group; that fixes 25-30 kg N/hectare through atmospheric nitrogen.
- Mycorrhiza is a fungus. Those are found in plant roots. Its presence increases nodulation and helps in N-fixation, besides P-absorption.
- Nearly 80,000 tonnes atmospheric nitrogen per hectare is above the ground, that can be utilized after fixing from pulses and bio-fertilizers.
- The average yield is increased upto 20% in pulses through Rhizobium culture; 18% in maize through Azospirillum; upto 25% in wheat, potato, mustard, cotton, sugarcane through Azotobacter; 20-25% in rice through BGA and 30% in rice through Azolla.
- There is direct saving of 20-25 kg N/hectare in related crops like—wheat, rice, pearlmillet etc. through the use of Azotobacter / Azospirillum, say; one bag of urea (50 kg).
- Website of Deptt. of Fertilizers—ww.fert.nic.in
- The soil pH range in acidic or alkaline reaction is expressed as;

  **Acidity**—Strongly acidic-below 4·5; very high acidic—4·5-5·0, high acidic—5·1-5·5; general acidic—5·6-6·0; light acidic 6·1-6·5 Neutral—6·6-7 (say 7·0).

  **Alkalinity**—Light alkaline—7·4-7·8, general alkaline 79-8·4, high alkaline 8·5-9·0 and very high alkaline—9·1 and above.
- Book **'Soil and Water Conservation Research in India'**—written by Dr. V. V. Dhruv Narayan.
- Said to be the Father of; **'Soil Testing Technique'**—M.L. Troug and **'Soil Micro-Biology'**—S.N. Winogradsky.
- In Atmosphere; $CO_2$ -300 ppm; N-79% and $O_2$ - 20·97% are present

- pF is the anti-log of soil moisture tension, which represents height (cm) of any water column.
- The soil moisture content at $\frac{1}{3}$ bar (pressure is called as **'Field Capacity'**, while soil moisture content at 15 bar is said to be the **Wilting Capacity**.
- The formula = $\frac{PW \times AS \times D}{100}$, is used to measure irrigation water depth.
- **Strength of Growth Regulator**—1,000 ppm means 0·1% solution or 1g/litre water or 1000 mg/litre.
- Tensiometer in soil can work upto 0·8 bar pressure.
- That process, wherein ammonia forms through organic compound is called ammonification.
- The oxidation of ammonia into nitrate, is called nitrification.
- Mineralisation is that process, wherein the carbonic form of nitrogen is changed into inorganic form.
- In cereal crops, the nitrogen fixation through Azotobacter and Azospirillum (bio-fertilizers bacteria) is called symbiotic nitrogen fixation.
- The soil colour is measured through the method of Mushell colour.
- Zero Tillage Technology in Wheat can save the cost by 28%.
- **CFQC & TI**—Central Fertilizer Quality Control and Training Institute Faridabad (Haryana)-having 74 laboratories in the country with 3 Regional Fertilizer Control Laboratories located at Mumbai, Chennai and Kalyani for testing, training fertilizers etc.
- Nitrogen (N) nutrient was discovered by D. Rutherford in 1772 and was found 78·4% N in atmospheric air.
- Fertilizer Control Order (FCO), 1985 and Essential Commodity and Fertilizer Control Order (FCO) 1985 are to ensure fertilizer standard quality to farmers.

### *Meaning in One Sentence*

- **ABC Soil**—The clearly developed profit of A, B & C layers of soil, is called ABC soil.
- **ATP (Adinosin Tri-Phosphate)**—It is the energyful of compound, that helps to increase some cell activities.
- **Crop log**—The graphic record of progress of any crop, that is the class/category of physical and chemical measurement.
- **Crop logging**—The identification of low or high amount of any plant nutrient in leaves of crop plants like-sugarcane.
- **Crop lodging**—The falling of crop by any means (like excess of water, nitrogen excess or fast/stormy winds), is called 'crop lodging',
- **HCN (Hydro-Cynic Acid)**—The poison present in the form of glucoside in leaves/stem of sorghum under dry & early stage, is called HCN (Prusic Acid/or Dhurin).
- **Ley Farming**—The growing of grasses on agriculturally usuable land in a agri-system and there after keep it as pasture for some years.
- **NADEP**—Narain Dev Rao Pandhari (Pandey) a compost method a farmer of Pusad, village in Yavatmal distt. of Maharashtra.
- **pH**—Anti-log of hydrogen ions.
- **pF**—The log of height (cm) of water column, that is equal to soil-force.
- **Pedology**—The Science of composition, life and its activities *i.e.,* origin, distribution and characteristic study of a soil, is called Pedology.
- Neem patented to India from USA (2005) and Neem Year 2007 was celebrated.

## *Multiple Choice Questions*

1. **'Pusa Neem'** (Neem-oil coated urea)—product used as inhibitors for slow release, was designated and reported by—
   (A) Dr. Rajendra Prasad and Colleagues
   (B) Dr. R.S. Paroda
   (C) Dr. G.B. Singh
   (D) Dr. M.S. Randhawa
2. Which of the following phosphatic fertilizer is useful in groundnut crop ?
   (A) D.A.P.
   (B) Rock Phosphate
   (C) Triple Super-Phosphate (TSP)
   (D) Single Super Phosphate (S.S.P.)

3. D.A.P. contains the N percentage—
(A) 9% (B) 18%
(C) 27% (D) 36%

4. The problem of iron toxicity generally exists in—
(A) Acid soils (B) Alkali soils
(C) Saline soils (D) Saline-Alkali soils

5. Use of gypsum is most beneficial in—
(A) Saline soils
(B) Alkali/Sodic soils
(C) Acid soils
(D) None of these

6. Phosphorus is generally fixed in acid soils in the form of—
(A) Calcium Phosphate
(B) Zn Phosphate
(C) Aluminium Phosphate
(D) None of these

7. Why gypsum is used in crop of mustard ?
(A) For supplying sulphur (s)
(B) For supplying N
(C) For supplying Fe
(D) For supplying P

8. In which soils, lime is used as soil-amendment ?
(A) Alkali
(B) Acid
(C) Saline
(D) Saline-Alkali solis

9. Which soil has more water holding capacity ?
(A) Sandy (B) Sandy-loam
(C) Clay (D) Clay-loam

10. Solid material formed from aggregate of minerals—
(A) Rocks (B) Moss
(C) Peat (D) Organic Matter

11. In pulse crops, N is fixed through—
(A) Azotobacter
(B) Rhizobium
(C) Nitrobacter
(D) Blue Green Algae (BGA)

12. The pH range of Alkali/Sodic soil is—
(A) 6-8 (B) 8·5-10
(C) 11-12 (D) 13-14

13. If wheat grain and straw contain 2·0 and 0·5% N, respectively and the corresponding yields of grain and straw are 40 and 60 q./hectare, then, find-out the total N–uptake—
(A) 100 kg (B) 110 kg
(C) 120 kg (D) 130 kg

14. The recommendation of rock-phosphate application is made in what type of soils ?
(A) Saline soils (B) Alkali soils
(C) Acid soils (D) Neutral soils

15. What type of N-fertilizer is suitable in water logged soil ?
(A) Ammonium Sulphate
(B) Urea
(C) Sodium Nitrate
(C) Calcium Ammonium Nitrate

16. The water potential in leaves of plants is measured by—
(A) Anemometer (B) Tensiometer
(C) Pressure Chamber (D) Gypsum block

17. Match the following—

**Indicator Crops**
(a) Citrus, Spinach, Sugarbeet & Tomato
(b) Ber, Apple, Onion & Litchi
(c) Lobia, Gobhi, Lucerne & Sugarbeet
(d) Rice, Wheat, Maize & Cotton

**Plant Nutrients deficiency symptoms**
1. Fe
2. Cu
3. Mo
4. Zn

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 3 | 4 | 1 |
| (C) | 3 | 1 | 2 | 4 |
| (D) | 4 | 1 | 2 | 3 |

18. Stem nodulation is found in—
(A) Sesbania aculeata (B) Sesbania rostrata
(C) Crotolaria juncea (D) Cicer arietinum

19. D.A.P. is a—
(A) Straight Fertilizer
(B) Mixed Fertilizer
(C) Compound Fertilizer
(D) Slow acting fertilizer

20. Which one of the following crops should be free from the use of chloride-fertilizer ?
(A) Tomato (B) Turnip
(C) Tobacco (D) Sugarbeet

21. The ideal C : N ratio of a good soil must be—
(A) 15 (B) 25
(C) 30 (D) 35
22. Compost manure, having raw material (crop residues, stubbles, dry leaves, straw etc.) exhibits the C : N ratio—
(A) 10 (B) 40 or above
(C) 25 (D) None of these
23. Which one of the following manure/fertilizers be given priorty for use to get maximum profit from a green manure crop ?
(A) N-fertilizer (B) P-fertilizer
(C) K-fertilizer (D) Organic manure
24. Which of the fertilizers be preferred to grow succeeding crop in green manured soil ?
(A) Nitrogenous (B) Phosphatic
(C) Potassic (D) Organic manure
25. Which of the following is helpful to convert ammonia ($NH_4^+$) to nitrate ($NO_3^1$) in soil—
(A) Nitrosomonas (B) Azotobacter
(C) Azospirillum (D) Micro-cocus

## *Fill-up the blanks*

1. An indicator plant is ….
2. The instrument used to measure soil moisture is called ….
3. Urea = N% × ….
4. Muriate of Potash = $K_2O$% × ….
5. Ammonium Sulphate = N% × ….
6. Area of an acre is equal to … hectare.
7. Area of one hectare = … × Acre.
8. One gallon (Imp.) = … litre.
9. P = $P_2O_5$ × ….
10. $P_2O_5$ = P × ….
11. $K_2O$ = K × ….
12. K = $K_2O$ × ….
13. Sugarcane (cane setts) constains … % jaggery and sugar percentage ….
14. Sugarcane (cane setts) contains … % juice and … % molasses.
15. Coconut (copra) contains …% oil and …% cake.
16. Bio-mass (or harvested rice crop) contains …% straw (Pual).
17. Seed cotton contains …% lint and …% cotton seed (Binola).
18. Groundnut kernel (seed) contains …% oil, while mustard seeds contains … % oil.
19. In which year …, National Remote Sencing Agency was established at Sikandrabad (Hyderabad, A.P.) ?
20. The Head Quarter of National Bureau of Soil Survey and Land Use Planning (NBSSLUP) is at ….
21. All India Soil and Land Use Survey Organisation (AISLUSO) was established in the year … at New Delhi (Head Quarter).
22. A developed soil has … horizons.
23. The downward movement of water in soil is controlled by ….
24. The **tarai** soils of Uttaranchal (say **tarai** of U.P.) show the deficiency of ….
25. Culturable (cultiable/arable) soil has the depth of … cm.
26. India has the largest area of alluvial soils, but second largest group of soil is ….
27. The size of soil particles is called …, whereas, the arrangement of soil particles is said to be ….
28. The range of diameter of silt particles is … mm, whereas diameter of clay particles is ranged between ….
29. The light soils of temperate region is called ….
30. Black soils indicate the deficiency of …, … and … nutrients/contents.

## *Select —True and False*

1. The **Khaira** disease in rice is caused due to the deficiency of Zinc (Zn). (…)
2. Saline-Alkali (or Saline Sodic Soils) has EC more than 4; pH more than 8·5 and Exchangeable Na more than 15%. (…)
3. In rice crop, new leaves turn into yellow-white due to deficiency of iron. (…)
4. Wheat is a $C_3$ plant. (…)
5. Tomato can be grown through-out the year, because of day neutral plant. (…)
6. The sunflower oil is considered of good quality, due to more (69%) amount of unsaturated fatty acids, that is useful to heart patient. (…)

7. Single Super Phosphate (SSP) is the example of straight fertilizer. (…)
8. In Ammonification, Pseudomonas bacteria helps to convert carbon-nitrogenous compounds into ammonia. (…)
9. Amongst nitrogenous fertilizers ($N^-$fertilizers), Ammonium Sulphate releases maximum acidity in soil. (…)
10. Among the phosphatic fertilizers (*i.e.* DAP, Rock Phosphate, Triple Super Phosphate and Single Super Phosphate); only Single Super Phosphate contains sulphur (S).
11. Bulk density of soil—

$$= \frac{\text{Mass of one cuft dry soil}}{\text{Mass of similar volume water}} \quad (\ldots)$$

12. % Pore space of soil—

$$= 100 - \frac{\text{Bulk Density}}{\text{Particle Density}} \times 100 \quad (\ldots)$$

13. % moisture in soil—

$$= \frac{\text{Loss in weight}}{\text{Oven Dry Weight}} \times 100 \quad (\ldots)$$

14. SAR (Sodium Adsorption Ration)—

$$= \frac{Na^+}{\sqrt{\frac{(Ca^{++} + Mg^{++})}{2}}}$$

(Wherein, all ions are expressed in milli equivalent) (…)

15. The evaluation of solubility of slow release (available) nitrogen fertilizers is called activity index, for which the formula is—

$$\text{Activity Index} = \frac{\text{CWIN} - \text{HWIN}}{\text{CWIN}} \times 100$$

(Here, CWIN = Insoluble Nitrogen in cold water (25°C);
HWIN = Insoluble Nitrogen in Hot Water (98-100°C) (…)

16. Transpiration Ratio (TR)

$$\text{T.R.} = \frac{\text{Quantity of available water in transpiration through plants}}{\text{Quantity of dry matter produced}} \quad (\ldots)$$

17. Drainage Coefficient (D.C.)—

$$\text{D.C.} = \frac{\text{Water discharge (cuft m/second) in 24 hrs}}{\text{Area in sq. meter}} \quad (\ldots)$$

18. Wilting Coefficient (W.C.)—

$$\text{W.C.} = \frac{\text{Hygroscopic Coefficient}}{0{\cdot}68} \quad (\ldots)$$

19. Moisture Index (M.I.)—

$$\text{M.I.} = \frac{\text{Total quantity of Available Water (P)} - \text{Evaporation (PE)}}{\text{PE}} \times 100$$

$$\text{Or,} \quad = \frac{\text{P} - \text{PE}}{\text{PE}} \quad (\ldots)$$

20. Organic Matter (O.M.) contains 58% organic carbon (O.C.) (…)
21. Exchangeable Sodium Percentage (ESP)—

$$\text{ESP} = \frac{\text{Exch. Na}}{\text{CEC}} \times 100 \quad (\ldots)$$

22. Productivity Rating Index (PRI)—

$$\text{PRI} = \frac{\text{Actual Yield (per ha)}}{\text{Standard Yield (per ha)}} \times 100 \quad (\ldots)$$

23. Plants absorb (take) nitrogen (N) in the form of nitrate ($NO_3^{III}$). (…)
24. Potassium Adsorption Ratio (PAR) is defined as—

$$\text{PAR} = \frac{K^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}} \quad (\ldots)$$

25. Stock's Law is expressed as—

$$V = \frac{9}{2} \times \frac{GR_2\ (PP–Pm)}{n} \quad (\ldots)$$

## *Give Answer in One Word*

(i) Urea contains Nitrogen (N%) ….
(ii) D.A.P. contains $P_2O_5$ (%) ….
(iii) Value of coefficient of correlation is equal to ….
(iv) Fe (Iron) helps in formation of chlorophyll ….
(v) Change of ammonia into nitrate through micro-organism is called ….

## ANSWERS

### Multiple Choice Question

| | | | | |
|---|---|---|---|---|
| 1. (A) | 2. (D) | 3. (C) | 4. (A) | 5. (B) |
| 6. (C) | 7. (A) | 8. (B) | 9. (C) | 10. (A) |
| 11. (B) | 12. (B) | 13. (A) | 14. (C) | 15. (A) |
| 16. (C) | 17. (A) | 18. (B) | 19. (C) | 20. (C) |
| 21. (A) | 22. (B) | 23. (D) | 24. (B) | 25. (A) |

## Fill-up the blanks

1. Maize
2. Tensiometer
3. 2·222
4. 1·666
5. 4·854
6. 0·4047
7. 2·471
8. 4·5461
9. 0·43
10. 2·29
11. 1·20
12. 0·83
13. 10, 9·97
14. 60-70, 3·5
15. 62, 38
16. 35-36
17. $\frac{1}{3}, \frac{2}{3}$
18. 40, 33-37
19. 1973
20. Nagpur
21. 1956
22. AB & C
23. Soil texture
24. Zinc
25. 15
26. Black
27. Soil texture, soil structure
28. 0·002-0·05, Below 0·002
29. Early soils
30. $P_2O_5$, N and O.M.

## True/False

All 1 to 25 — True

## Answer in One Word

(i) 46 (ii) 46
(iii) ± 1 (iv) Yes
(v) N–fixation

**Agricultural Growth in India (Decade & Sourcewise)**

| Sources | 1980's | 1990's |
|---|---|---|
| **(A) Source & decadewise—** | | |
| ● Yield | 54 | 29·3 |
| ● Diversification | 26·6 | 30·7 |
| ● Area | 10·1 | 4·0 |
| ● Prices | 7·7 | 35·2 |
| ● Interaction | 1·6 | 0·8 |

**(B) Agriculture Sector Share (%) in total GDP** (Gross Domestic Products)—(decreasing trend ↓)

| | 1950-51 | 2004-05 | 2009-10 | 2010-11 | 2011-12 |
|---|---|---|---|---|---|
| ● Agriculture* contribution (%) | 52·2 | 21·0 | 14·7 | 14·5 | 13·9 |

*A live source of 75% human population of India ;

**(C) Fertilizer Nutrients consumption NPK kg/ha**

| | 1951-52 | 2004-05 | 2006-07 | 2009-10 | 2010-11 |
|---|---|---|---|---|---|
| NPK (Kg/ha) Use | Below 1·0 | 104·5 | 113·26 | 135·8 | 144·14 |

**(D)** Fertilizer N : P : K ratio use

| 1992-93 | 2000-01 | 2003-04 | 2004-05 | 2005-06 | 2008-09 | 2009-10 |
|---|---|---|---|---|---|---|
| 20 : 5 : 1* | 7·0 : 2·7 : 1 | 6·5 : 2·5 : 1 | 5·7 : 2·2 : 1 | 5·3 : 2·2 : 1 | 4·6 : 2·0 : 1 | 4·3 : 2·0 : 1 |

* At decontrol of Phosphatic (DAP) & Potassic fertilizer-its ratio disturbed during 1992-93; Ideal NPK ratio 4 : 2 : 1 in cereals & 1 : 2 : 1 in pulses.

**Strength of solution for growth regulators/or Chemical**

1 ppm (part per million) = 0·001 g/litre water
10 ppm = 0·01 g/litre water
100 ppm = 0·1 g/litre water
1000 ppm = 1 g/litre water,

Since, $\% = \frac{\text{ppm}}{10{,}000}$

or, ppm = % × 10,000

*i.e.* 0·1g/litre water = 100 ppm (0·1%)
0·2 g/litre water = 200 ppm (0·2%)
1 g/litre water = 1000 ppm (1%)
2 g/litre water = 2000 ppm (2%)

●●●

# 5 TRANQUILLITY HORTICULTURE [FRUITS, FLOWERS & VEGETABLES]

(**'Flower'**—stands for **3** things symbolically *viz*. **Beauty, Love** & **Tranquillity/Peace/Calm**)
(**Horticulture =** Hortus (garden) + culture/coleure (cultivation)—**two Latin words**)

## (i) General

- Horticulture – Origin from two Latin Words **'Hortus'** and **'Coleur'** or/'culture', meaning garden and cultivation, respectively.
- **Branches of Horticulture**—
  Olericulture — Vegetable Science
  Pomology — Fruit Science
  Floriculture — Flower Science (Flower Cultivation)
  Fruits and Vegetables Preservation - a part of horticulture.
- **India's rank (position) in world**—
  India ranks-II (13%) in vegetable production (after China) in the world.
  India ranks II in fruit production (10%) in the world.
  India is the largest producer country of turmeric (76%) and ginger (65%), of the world production.
  India has 18% share in world trade of spices.
  India is the largest producer, consumer, & exporter of cashew in the world, producing 40% of the world production.
  India has **'first'** rank in the world in production of mango, coconut, cashew, spices, tea, banana and cauliflower.
  India has **'second'** place in fruit production in the world, in vegetable production—Onion-II & Cabbage III rank.
  Venezuela country has the highest productivity of mango in the world.
  India has **'4th'** rank in potato area **'3rd'** in production (China I & Russian Union II) and 10th place in potato productivity (per hectare yield) in world.
- **Causes of Pungency in Fruits, Vegetables & Others—**Bitterness in Aonla (fruits)—due to Polyphenole, Galic Acid, Ilogic Acid & Tenin.

Pungency in Chillies (fruits)—due to Capsaicin alkaloid.

Bitterness in Badam—due to Imailedin

Bitterness in Pepper—due to Marmelosin

Odour in Pepper—due to Oleriosin

Content/compound in Neem—

* Neem bark & root (On extraction)—Nimbin
* Neem leaf—Nimbin, Nimbinene, Nimbandial and Quercetin
* Neem flower—Sterols, Thiomyl alcohol, Benzyl alcohol, Benzyl acetate and essential oil.
* Neem Kernel/Seed/Fruit—Nimcidin, Azadirachtin compound

(All 5 Neem plant parts—root, bark, leaf, flower & seed (fruit/Niboli) have medicinal value)

Pungency (Smell/Special odour) in Onion—due to Allyle Propyl di-sulphide

Pungency (smell) in uninjured garlic—due to Allinase, Amino Acid, that on crushing, it changes into Allicin.

Pungency in Crushed garlic—Allycin

Special Odour in fresh/raw garlic—due to Allyle Radical di-sulphide.

Bitterness in Bittergourd—Memordicoside, Tetra tri-terpine.

Acridity/Bitterness in Arbi (Arum/Colocasia)—due to calcium-oxalate

Acidic Taste in Gram leaves—due to Tenin

Pungency in **Toria** Oil—due to Allyl Isothiocynate.

Pungency in Mustard oil—due to Glycoside singrin ($C_{10}H_6O_9NS_2K$)

Rancidity in Sunflower oil—due to oxidation.

Paralysis/Reumatism in use of Lathyrus—due Neurotoxin or Lathrogen Alkaloid, or

BOAA(Beta-Oxalyl-di-Amino α-Alanine), a Neurotoxil compound.

- **Causes of colour development in fruits, vegetables & others**—

  Liquidification in Bael—due to Marmelosin

  Red colour in Tomato (fruits)—due to Lycopin

  Yellow colour in Onion—due to Quercetin

  Yellow colour (yellowishness) in Turmeric—due to Curcumin

  Orange colour in Carrot—due to Carotin

  Red colour in Carrot—due to Andhocyanin

  Red colour of Chilli—due to Capsanthin

  Green (skin) colour in Potato—due to Solanin

  Yellow colour in Papaya—due to Carica-xanthin Pigment

  Yellow colour in oil of oilseeds—due to Alyl-Iso-thiocyanate-a carotinized compound and sometimes greenish colour—due to chlorophyll.

- **'Father of Fruits' and Vegetables Preservation**—M.Nicolus Apart.
- **Fruits Growing States of India**—

  **Temperate Fruits**—J & K, Kangada Valley (Punjab), Nahan (Himachal Pradesh) and Kumaon Hills (Uttaranchal)

  **Tropical Fruits**—Madhya Pradesh, West Bengal, Maharashtra, Orissa, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala.

  **Subtropical Fruits**—Plains of Punjab and Uttar Pradesh, North Bihar, Madhya Pradesh, Rajasthan, Assam.

- ## Growth Regulators for Fruits & Vegetables

  **Growth Promoters**—Cytokinins, Z.R., DHZR, Indole Acetic Acid (IAA), wherein Auxins; Gibberellins and Cytokinins are present.

  * **Auxins** : (i) **Natural**—IBA (Indole Butyric Acid), I.A.A. (Indole Acetic Acid) and

    (ii) **Synthesised**—2,4–D, 2, 4, 5–T, MCPA etc. for promoting plant growth.
  * **Gibberellins** : GA (Gibberellic Acid—$GA_1$, $GA_2$, $GA_3$, $GA_4$, $GA_5$) for increasing the growth of dwarf plants.
  * **Cytokinins** : (i) **Natural**–Zietin,

    (ii) **Synthesised**—Benzoil Adinin (BA)—Association in growth of plants.

  **Growth Inhibitors**—That checks (Control) the growth of plants, *e.g.* Abscisic Acid, (ABA), Phenoles, Malic Hydrozoide( MH), 'CCC' (Cycocel), B–9, Phosphon–D etc. These (growth retardents) redard the plant growth.

- **For controlling fruit droppings**—NAA (Napthelin Acetic Acid or Planofix); 2, 4-D; 2, 4, 5–T—use @ 10 ppm.
- **Climacteric Fruits**—These are mango, papaya and banana; whereas, the non-climacteric fruits are grape, mandarin and orange.
- ## Hybrid Varieties

  **[Hybrid cross ♂ (male) × ♀ (female)]**—

  (A) **Fruit—**

  **Mango**—Mallika (Neelum ♂× Dashahari ♀), Amrapali (Dashahari × Neelum), Ratna* (Neelum × Alphonso), Sindhu* (Ratna × Alphonso), Neeleshwari* (Neelum × Dashahari), Manjira (Romani × Neelum), CISH M-1 (Amrapali × Janardan Pasand), Arka Anmol( Alphonso × Janardan Pasand), Arka Puneet (Alphonso × Banganpalli), Arka Neelkiran (Neelum × Alphonso), Arka Aruna (Banganpalli × Alphonso), Neelphonso* (Neelum × Dashahari), Neeleshara* (Neelum × Baneshan), Mango Hybrid 1084 (Amrapali × Janardan Pasand), Hybrid 39 (Amrapali × Vanaraj), Hybrid Pusa Arnima (Amrapali × Sensation), Hybrid Arunika (Amrapali × Vanraj

  (* **'Sindhu'**— a seedless mango fruit, developed from Regional Fruit Research Station Vengurla of Konkan Krishi Vidyapeeth Dapoli, Maha. and Ratna developed in 1981 from same centre)

  * Neeleshwari, Neelphonso and Neeleshan, developed at Fruit Research Station, Paria (Gujarat)

  * Off season Mango—Rumani variety.

  **Guava**—Hybrid-1 (Allahabadi Safeda×Seedless), Hybrid–45

  [Allahabadi Safeda × Sardar (Lucknow 49)], Hybrid-16-1 (Apple colour × Allahabadi Safeda).

  CISH-G-1—Deep red fruit, high TSS content (15° Brix) & long shelf-life.

  **Apple**—Red Ambri (Red Delicious × Ambri), Ambrich

  (Rick-a-red × Ambri), Shanburry (Ambri × Golden Delicious).

**Citrus**—Limquat (Cumquat × Best Indian Lime), Kinno Orange (King Orange × Willowleaf Mandarin).

**Grape**—Arka Shweta (Anab-e-shahi × Thompson Seedless), Arka Majesty (Angular Kalan × Black Champa), Pusa Urvashi (Har × Beauty seedless), Pusa Navarang (Madelin Ignovine × Ruby Red).

**Sapota**—Hybrid Co-1 (Cricket Ball × Oval)

Banana Hybrid NPH-02-01 (cross between H-201 × Anaikomban)-registant to fusarium wiet race 1.

**Ber**-Hybrid Thar Sevika (Seb × Katha)-high TSS (22%) sugar & protein rich.

## ● Horticultural Research Station

International Institute of Horticulture (IIH), **Brazil** (South America)

Indian Institute of Horticultural Research (IIHR), Hessarghatta, **Bangalore**—(Est; 1968).

National Research Centre for Citrus (NRCC) **Nagpur**, Maha. (Est. 1986).

Central Institute for Sub-tropical Horticulture (CISH), **Lucknow** (Est. 1995) (Earlier CINNP—Central Institute for North Plain Horticulture, Est. 1978).

Dr. Y.S. Parmar University of Horticulture & Forestry, **Solan** (Himachal Pradesh) (Est. 1978).

Central Institute for Temperate Horticulture (CITH), **Shrinagar** (J & K). (Est. 1991)

Central Plantation Crop Research Institute (CPCRI), **Kasargod** (Kerala) (Est. 1970)

Central Potato Research Institute (CPRI), **Shimla** (Himachal Pradesh) (Est. 1949)

Central Potato Research Institute (CPRI) Campus **Modipuram**, Meerut (U.P.)

Central Tuber Crops Research Institute (CTCRI), **Tiruvananthpuram** (Trivendrum), Kerala (Est. 1963).

Central Institute of Spices Research (CISR), **Calicut** (Kerala)

Indian Institute of Vegetable Research (IIVR), **Varanasi** (U.P.)

National Research Centre for Banana (NRC–B), **Tiruchirapalli** (T. Nadu) (Est. 1993)

National Research Centre for Cashew (NRC–C), **Puttur** (Karnataka) (Est. 1986)

National Research Centre for Grapes (NRC–G), Pune (Maha.) (Est. 1997)

National Research Centre for Mushroom (NRC–M), **Solan** (H.P.)

National Research Centre for Oilpalm (NRC–O), **Eluru Pedavegi** (A.P.) (Est. 1995)

National Research Centre for Onion and Garlic, (NRC–O & G) **Pune** (Maha.)

National Research Centre for Orchid (NRC–O), **Gangtok** (Sikkim).

Horticulture Division of Indian Agril. Research Institute (IARI) Pusa Campus), **New Delhi**–110001. (Est. 1936)

Central Arid Horticulture Institute (CAHI), **Bikaner** (Raj.) (Earlier National Research Centre for Arid Horticulture, Est. 1993)

Central Coconut Research Station (CCRS), **Kayangulam** (Kerala) (Est. 1947)

National Horticulture Board (NHB), **Gurgaon** (Haryana) (Est. 1984)

National Horticulture Mission (NHM) was declared by the Prime Minister to double the Horticulture production by 2010.

## ● Important Research Achievements

**(i) Fruits**—

**Mango**—**Mango 'National fruit'/or also called a 'Bathroom Fruit'** : Rejuvenation Technology has been developed to come re-bearing/fruiting condition of old (40 years and above) and non-bearing mango trees. IIHR, Bangalore has developed a good mango variety **'Arka Puneet'**.

**Guava**—For commercial production, **'Lalit'** variety of guava has been developed from CISH, Lucknow, which has solid pink flesh, outerskin saffron-yellow colour and redish attractive medium fruits. Two other hybrids namely; H-21 (Red flesh) and H-136 (more TSS) have also been released. HAPSI–35 & HAPSI–46 (both suitable for nectar making) and HAPSI–16 (Vitamins can safe for longer period).

**Citrus Group**—It has made a success for controlling bacterial canker through (i) Pruning in lemon and (ii) 3-4 foliar sprayings at one month interval of Streptocycline (100 ppm) + Copper Oxychloride (0·3%) solution.

**Papaya**—Hybrid **'Surya'**, having medium sized fruits, weighing 600-800 gm, red flesh, high TSS (14° brix), has been identified.

**Pineapple**—In **Barani** areas, pineapple plantings be done at a spacing to achieve 44,444 plants per hectare.

**Aonla**—Lakshmi-52-selection, Pratapgarh, U.P., 2–2·5 q/tree fruit yield (10 yers onwards)

**(ii) Vegetables**—

Some of the varieties of crops, like—watermelon- 'MHW–6' Tomato–'Sun 496' and Bottlegourd–BPOG–1 from Pantnagar have been identified.

**Hybrids from IIHR Bangalore, developed**—Lobia–'Arka Samradhi', Tomato–'Arka Abhijeet' and 'Arka Abha'; Frenchbean–'Arka Subidha' and 'Arka Bold'; Red Chaulai–'Arka Arudima'; and Palak–'Arka Anupama'

Kufri Pukhraj, Kufri Chipsona–1 & 2, Kufri Giriraj and Kufri Anand of Potato varieties were released.

For Indian Potato, **'DNA'** based finger printing techniques have been developed.

Intercropping of 'potato + garlic' is found useful to control late blight and tuber rot diseases.

A justified success has been made in development of Bio-low grade plastic based from starch of cassava and recommended/affiliated completely by the ICAR and NRDC. This technology has been transfered in the country, which is Europe patented.

The variety of Sweet potato—'Shree bhadra' is found suitable as **'trap crop'** in controlling root-knot nematodes.

Some of the varieties, like-'Arka Anamika' and 'Arka Abhay' of Lady's finger (Okra) and **'Arka Neel Kant'** and **'Arka Keshav'** of brinjal from IIHR have been developed.

**(iii) Flowers**

The varieties of gladiolus (Gladiolus spp.), like—'Shagun' and 'Shran-garika' have been developed.

Guldavdi (Chrysanthemum Spp.) variety 'Diana' is a small flower type.

For carnation, hybrid of marigold namely—'Pusa hybrid–1' has been developed.

**(iv) Medicinal**

The new varieties of Isabgol—Mandsaur-1 (M-1) and Pamarosa—CI-80-68 have been found good.

- ## New Varieties of Important Commercial flowers

**Marigold (Tagetes erecta)**—Bolero, Butter Scoch, Brown Scout, Goldy, Golden Jam, Lemon Jam, Hybrid Climax, Red Glo, Pumila (dwarf), Honour, Red Head and Red Pigmi etc.

**Guldavadi (Chrysanthemum Spp.)**—

(1) **White Flowers**—Jotsna, Sharad Sona, Mercury, Birbal Sahni and Himani;

(2) **Yellow Flowers**—Aparna, Sharad Shrangar and Kundan Topaj;

(3) **Red Flowers**—Jaya, Jam and Garnet;

(4) **Hybrids**—Akash, Ravi Kiran, Yellow Star, Chandra Kanta, Swarn Shrangar, & Rajat Rekha;

(5) **Other Varieties**—Basanti, Pusa Narangi.

**Carnation**—Arthur Sim, Scania, Aspana, Pameer, Red Corso, Sems Pride and Scarlet Aligans.

**Jasmine**—(i) **Jasmine grandiflorum**—CO-1 Pichy

(ii) **Jasmine Auriculatum**—Perimullai and CO-1 mullai.

**Tuberose (Polianthes tuberosa)**—In three types—Single, Mid and Double; Varieties–Light Pink Prize, Rajat Rekha and Swarn Rekha.

**China Aster**—Kamini, Poornima, Shashank and Violet Cushion.

**Bougainvillea**—Archna, Arjun, Begum Sikander, Chitra, Mary Palmer Special, Nirmal, Parthasharthi, Surekha, Sweta and Wazid Ali Shah.

**Gladiolus**—Carmine, Dhanvantari, Happy End, Hunting, Soung, Mayur, Najrana, Oscar, Poonam, Sapana, Shakti, Suchitra, Yellow stone, White Prosperity and Friendship.

**Hibiscus**—Ekta, Anuradha, Anurodaya, Ashirbad, Basant, Bharat Sundari, Chitralekha, Dilruba, Geetanjalli, Jagan, Neelofer, Pakeeja, Phulkari, Priya, Queen of Hessarghatta, Ratna, Shanti, Smt. Indira Gandhi, Smt. Kamla Nehru, Tribal Queen—All these varieties have been developed by IIHR, Bangalore.

**Galardia (Seasonal & Perennial)**—Single Indian Chief, Tretafeasta, Double Laurengiana, Regalis, Sanguintha (Summer season flower).

**Rose**—Pusa Gaurav (developed by IARI)

**Aromatic Plants**—

* **Khus** (Vetiver–Vetiveria zizanioides)—Sugandha, KS-1 and KS-2.
* **Palmarosa (Rosagrass/Rosaghas–Cymbopogon martinni)**—Motia, Trashna, PRC-1.

* **Lemongrass (Cymbopogon flexuosus)** —LS-48, Clone-29.

- **Self Pollinated Vegetables**—Tomato, Lobia, Beans, **Guar** (Clusterbean), Menthi, Peas and Brinjal are self-pollinated vegetable crops; whereas, cross pollinated crops of vegetables are–Cucurbits-bottlegourd **(Lauki)**, Sponge gourd **(Torai)**, Cucumber **(Kheera)**, Pumpkin, Bittergourd, Tinda, Watermelon, Muskmelon, Turnip, Radish, Carrot, Cauliflower, Palak, Chaulai and Kulfa.
- **Juvenile Stage**—The growth of early or vegetative stage of plants, that represents to use of carbohydrates.
- **Matrix**—That place on root-stock, which is prepared for fusion of scion or bud.
- **Parthenocarpic**—That fruit, which is developed without fertilization.
- **Pinching**—Topping of all apical vegetative parts, so as to allow growth of side axillary buds.
- **Deciduous Plants**—When plants get resting (dormant) stage and the leaves fell-down once in a year on the ground, especially in forest trees.
- **Temperate fruits**—A fruit tree, that requires cold duration and deciduous plant, *e.g.* Apple, Pear, Adoo, Aloocha etc.
- **Sod Culture**—The cultivation of grasses in orchard.
- **Tropical fruits**—Those fruit trees, that remains ever-green and can not tolerate freezing temperature etc. Banana, Coffee, Pineapple.
- **Truck Gardening**—Raising some limited vegetables on large scale; their sale on large scale or export through sea-ways.
- **Vegetable forcing**—A system of gardening, wherein growing vegetables in uncommon weather.
- **Cauliflower**—(Caulis = Cabbage, floris = flower & variety – botrytis = budding.) It is a Latin word *i.e.* cauliflower.
- Indian Spices Research Institute, kalicut (Kerala) has created a largest storage/ collection of germ-plasms related to black-pepper, garlic, turmeric and tree-roots in the world.
- In Faizabad of U.P., a good variety of cashew–**'Florites Sedger'** has been found suitable in houses.
- Red Skin **'Sweet potato'** can be stored for a longer period compared to white skin sweet-potato.
- National Horticulture Board (NHB) in Horticulture development (Est. 1984 at Gurgaon, Haryana); Agricultural Processed Food Export Development Agency (APEDA), National Bank for Agriculture and Rural Development (NABARD), and Neitherland Finance Company (NFC) are providing technical knowledge and financial assistance to the Indian farmers.
- **Bonsai**—It is a Japanese art, wherein excess dwarfing of plants is done to prepare small plants (5 to 20 cm height).
- **Auxins**—A natural hormone, that checks the growth of lateral buds of plants and are produced in apical region of plants *e.g.* IBA and IAA.
- **Bolting**—It is a physiological disorder in cauliflower, wherein in off-season/early season, flower spikes are emerged, produce seeds and finally die before the end of season.
- **Blanching**—Giving heat treatment for a certain period to fruits, or vegetables in boiling water or in steam, so that the enzymes become in effective before freezing.
- **Crazy top**—A special type of growth in citrus trees, especially in alkali soils.
- **Callus**—A developed shape or structure of Knot type of damaged tissues through cambium; *e.g.* in air layering (goottee) at up-side.
- **Commercial Floriculture**—A sector of horticulture, wherein, cut-flowers, flower plants of pots, leafy plants and cultivation of bedding plants are done for commercial production.
- **Day Neutral Plants**—Those plants, produce blossom (flowers) in day light at any day, *i.e.* no effect of light duration on flowering of plants *e.g.* cotton, sunflower and tomato.
- **Green House**—The man-made structure, that is useful to plant growth.
- **Hydroponics**—Growing plants in water without soil, wherein plant nutrients are given in water.
- **Indoor Gardening**—Growing of domestic plants, their arrangement and demonstration, those are used for decoration in houses.

- **Informal Gardening or Land Scaping Gardening**—A system of gardening and use of materials for the improvement of any area, so that a new shape or face of a particular area can be given.

## (ii) Fruit Cultivation (Pomology) (National Fruit-Mango (Manifera indica)

- **'Lalit'**—A variety of guava is considered as dual purpose *i.e.* for table and processing purposes, having red flesh.
- **'Pomato'** is a cross between Potato × Tomato.
- Mallika, Neelum and Banglora are the regular fruit bearing varieties of mango.
- **'Alphonso'** is a exportable variety of mango.
- N.A.A. (Nepthalene Acetic Acid) chemical is used to control malformation in mango.
- 2n = 28 are the chromosome numbers in litchi.
- Metaxenia process in datepalm is related to pollination.
- From botanical point of the fruit of **'fig'** is a cyconus.
- Caprification is related to fig.
- An evergreen fruit– **'Olive'** is associated with the emblem of United Nations.
- The fruiting crop of guava in April-May months is called **'Mrig Bahar'**.
- For propagation in banana; 3-4 months aged/old suckers are suitable.
- 2, 4-D and 2, 4, 5-T can be used @ 25 ppm foliar spray for controlling fruit droppings in citrus. NAA can also be used @ 1 ml/40 liter water spray.
- In guava, the appropriate timing of flowering for 'Ambay Bahar' is July-August.
- There are generally three Bahars for fruiting in guava *viz*. Ambay, Mrig and Hasth Bahar.
- Spraying of GA (Gibberellin or Gibberelic Acid)–40 ppm before fruit-setting for improving the berry size, bunch weight and quality is a commercial practice in grapes.
- Strawberry is a short day plant.
- **'Citrus Canker'**—A disease in citrus is caused due to 'Xanthomonas citrii'.
- **'Kinnow'** is a cross of sweet orange × willow Leaf Mandarin.
- New York (US) is called as 'Big Apple City'.
- **'Tangers'** is a cross of Mandarin × Sweet orange
- In North India, in grape, the pruning is generally done during December-January months.
- In all fruit crops, for the control of fruit-dropping, the foliar application of 2, 4-D; 2, 4, 5-T and N.A.A. (Nepthalene Acetic Acid) is done.
- Growth inhibitors are Abscisic Acid and Ethylene.
- Growth promoters are the auxins *e.g.* IAA, IBA, IPA (Indole Pyruvic Acid) and Gibberellin ($GA_1$ to $GA_5$.)
- Tropical fruits are; Mango, Papaya, Jackfruit, Ber & Coconut.
- Sub-Tropical fruits are; Litchi, Guava, Grape, Pomegranate, Jamun, Aonla, Shahtoot etc.
- Temperate fruits are; Apple, Adoo, Pear, Loquat, Cherry, Strawberry etc., which grow in cool climate.
- Non-climacteric fruits are; Grape, Mandarin and Orange.
- Climacteric fruits are; Mango, Papaya, Banana etc.
- Boron is associated with *'Internal Necrosis'*—a disease in Aonla.
- **'Ring budding'** in **Ber** for propagation is used as commercial level.
- Annual pruning is done in plants of fig.
- India's share in world mango production is about 65%.
- Maharashtra produces maximum citrus in the country.
- Parwal and Papaya are the diocious plants, having male and female flower on separate plants.
- **'Cycocel'** (or 'CCC') is a growth controlling chemical, when used as spray.
- A plant, having both male and female flowers is called monoecious plant *e.g.* Bottlegourd (lauki).
- Abscisic Acid is a natural growth inhibitor.
- Apomixis is related to onion and citrus.
- Weeping Jelly is obtained under low sugar and on slow cooking.
- 'Damping off' in papaya is caused due to fungus.
- Vit. 'C' is called Ascorbic Acid *e.g.* in Aonla.
- In mango, carotinised pigment is a good source of Vit. 'A'.

- Powdery mildew disease in mango is caused due to **'Oidium mangiferae'.**
- For inarching, root stock is prepared through seed.
- **'Panama'** is a wilt disease in banana, caused by **'Fusarium oxysporum'** var. cubense.
- Removal (cutting) of undesirable suckers in banana is called de-suckering.
- For one hectare planting of mango orchard, 100 plants would be required at spacing of 10m × 10m (Plant × Row).
- For jelly making, the pH value of juice should be 3·3.
- Citrus contains Citric Acid.
- **'Pusa Nanha'**—A dwarf Papaya is a good fruit bearing variety.
- Training in Grape is a essential process.
- For controlling the growth direction of a plant is called training.
- Training of plant had very little adverse effect on fruit bearing.
- Andhra Pradesh is the **'largest'** fruit producer state of India.
- Maharashtra ranks **'first'** in fig production.
- U.S.A. is the largest citrus producer in the world.
- Pruning helps in development of fruit size and colour improvement.
- The success of grafting in plants depends up on the combatibility between scion and root-stock and cambium tissues.
- Generally fruits abrupt (worst-out) due to creation of pressure on cell-wall of plants through more water absorption and low transpiration.
- Datepalm is a single seeded berry fruit.
- Citrus fruit is a modified berry fruit, which is called Hesperidium.
- A pollenizer must have the quality of producing more pollens, so that good possibilities of cross-fertilization become sure.
- In mango, flowers come-out (appear) generally on old autumn and summer growth.
- The pruning of trees having nitrogen deficient creates more unproductiveness.
- The fruit size increases with the use of growth substances.
- Auxins creates abortion in developed and developing embryo; resulting thereby thinning of fruits.
- The unsaturated hydro-carbon (Ethylene) stimulates the fruit ripening process.
- The fruits have waxy cuticle *e,g*. in Apple, whereas in tubers, corky epidermis (in potato) is found, so that the loss of water can be reduced.
- The bacteria found in fruits and vegetables can be destroyed (killed), if kept open for 15 to 30 minutes at 212° F temperature and 30 to 60 minutes at 240° F temperature.
- Mostly fruits are lost (damage) in storage, if concentration of $CO_2$ increases above 1%.
- Any product, which has above 65% sugar, can be preserved permanently *i.e*. for a longer period.
- For permanent preservation of fruits and vegetables, the concentration of common salt should be 15-20%.
- The use of plant growth regulators in vegetative plant propagation helps in promoting rooting-process of cutting.
- The best time of pruning in **Ber or Jujube (Ziziphus spp.)** in North India is 15 May to 15 June.
- In Japan and China, the use of lemon in root-stock is made extensively in application.
- **'Sindhu'**—A hybrid mango is the cross between 'Ratna × Alphonso'.
- The cause of malformation in mango is the imbalance between growth promoters and growth inhibitors.
- The excess of **'papain'** enzyme in unriped fruits of papaya helps in digestion of protein.
- **'Chinese Pot Layering'** is ideal for air layering.
- Fruit producing hormone is floregin.
- Removal of branches and top portion of plant-stem alongwith leaves is called **'pinching'**.
- A 100 g ripe part of mango contains 4800 Vit. A (IU), while gooseberry has 2380 I.U. (Vit. A).
- In grape-fruit, citrus and lime, 100 g fruit contains zero quantity of Vit. A(IU).
- In **Aonla**, 100 g portion contains maximum quantity of 600 mg of Ascorbic Acid.
- 'Laxmi-52' Aonla variety developed by Tej Bahadur Singh (farmers, village—Bhadausi, Garbara, Pratapgarh (U.P.) & released by the ICAR.

- A 100 g portion of Sapota **(Chiku)** contains maximum energy–110 (IU).
- A 100 g edible portion of Sapota (Chiku) contains maximum protein *i. e.,* 9·8 g, compared to other fruits.
- A 100 g edible portion of Sapota (Chiku) contains 1·9 mg fat.
- In Mango, Badam (Almond), Loquat, Cherry, Apple, Pear, Litchi and Plum (Alubokhara), the cross pollination process is occured.
- In Banana, Pine-apple, Aloocha etc. fruit trees,; suckers are used naturally in vegetative propagation.
- In strawberry, the vegetative method of propagation is done through **'runner'**.
- In fruit trees like; Datepalm, Pine-apple etc., the vegetative method of propagation is done through **'Off-set'**.
- In Banana, **rhizomes** are also used in vegetative propagation, besides suckers.
- Uttar Pradesh is the **'largest'** guava producer state in India.
- A branch of citrus, covered by soil through curve without removal from mother plant for vegetative propagation, is called **'simple ground layering'**.
- Trench layering is also adopted in fruit tree for propagation.
- In **'custard-apple'** (Sharifa), propagation is done commercially through seeds.
- In Jamun, Walnut, Jackfruit, Cashew and Papaya, the commercial vegetative propagation is meant through seeds.
- Coconut Development Board (Ministry of Agric, Govt. of India) is in Kerala at **Kochi**.
- Indian Institute of Horticultural Research (IIHR), Bangalore, is an ICAR Institute.
- **'Arka Soma'** and **'Arka Trashna'** varieties of grape are suitable for good quality wine production.
- In Elephant-Foot-Yam (Zimikand), the tubers should be dipped in solution of thiorea for breaking dormancy.
- Spraying of GA-3 is suitable to control sprouting in white Yam.
- In orchard planting, hexagonal system (Equilateral-Triangular System) accommodates 15% extra plants compared to square system.
- The origin place of Phalsa, Bael, Mitha Nimbu (Sweet lime) and Sour lime is India.
- China is considered as the origin place of Litchi, Adoo, Shahtoot and Khuwani.
- There has been a success in post-harvest management in fruits, *i.e.* Alphonso Mango can be stored for 30 days under controlled condition at 5% $O_2$ and 3-4% $CO_2$; whereas, in Baneshan Mango, the conditions must be at 5% $O_2$ and 1·5-2·0% $CO_2$ for 35 days.
- **Karonda (Carissa caranda)** contains maximum Fe content and it is originated from India.
- **Kachai lemon**—Identified in village—Kachai, Distt.—Ukhrul (Manipur), bearing 1-3 thousand fruits/tree, uniform colour fruits, special flavour, high juice content etc.
- **Plum-EC 34052**—Introduced from Kenya, a high yielding and prolific bearing.
- **Ber-'CIAH–Hybrid-1'**—Recently developed from '**CIAH**'—Central Institute of Arid Horticulture, Bikaner (Raj.) and multiplied by Patch budding.
- Jamun CISH-J-37.

## (iii) Flower Cultivation (Floriculture)

- **National flower—**Lotus (Nelumbo nucipera Gaertn)
- The Science/knowledge and an Art of growing flowers is called 'floriculture'.
- **'China Aster'** varieties are; Purnima, Kamini, Phule Ganesh (Pink) and Phule Ganesh (Violet), and Carnation Hybrid II HR-P-1.
- **'Diana'** is the variety of Chrysanthemum.
- **'Shagun'** & **'Shrungarika'** are the Gladiolus varieties.
- **Bonsai** plants have 5-20 cm height *i.e.* for the use of Indoor Gardening, the dwarfness is produced in plants. Since, **Bonsai** is too old Japanese art, meaning thereby Bonsai = stand plants in basin **(Thali)**.
- The Optimum time of planting 'Lawn' is February-March and July-August months.
- For controlling the powdery mildew diseases in Chrysanthemum, spraying with Karathane (Benlate 0·1% solution) is effective. Similarly, for checking the losses caused by 'Septoria Leaf Spot' disease, spraying of Bavistin (0·1%) is useful.
- In Gladiolus, the vegetative propagation is meant through corm and cormlet.
- **'APEDA'** gives technical advice for growing flowers under green house conditions.

- **'NABARD'** provides financial assistance for horticulture development.
- Floral buds need higher (maxi.) temperature compared to leafy buds.
- Long and short day plants induces (increases) flowering process in abundance of carbohydrate and nitrogen, respectively.
- In Floriculture *i.e.* ornamental plants, 'T' or Shield budding is suitable in vegetative propagation.
- Chrysanthemum (Guldavadi), Marigold, Babycorn and carnation plants require pinching.
- Transfering of young seedling from one Tray/pan to another is called prinking.
- In rose propagation, the investigation 'Poly bag' method was developed by N.A. Joshi.
- Mughal's used to love to **'rose'**, but for the research/investigation of 'rose-oil', the credit goes to Empress Noorjahan.
- Although, the researches on rose were started in the year 1956 at IARI, but in 1968, the first varieties of rose were developed namely; Pusa Sonia and Sarvodaya.
- Some of the practices are adopted for marking **Bonsai** (Dwarfness) of plants, *viz.*; root pruning, breaking of apical buds, cutting of thin branches, time to time cutting of some thick branches etc. This helps in controlling/ limiting the size and shape of plants and plants remain smaller in size.
- **'Cascade'** is a Japanese popular art, for making the plants **'Bonsai'** (dwarf), wherein branches move in semi-circle around the main stem.
- The plants suitable for making **Bonsai** are; (i) **In Evergreen plants**—Banayan, Pomegranate (in plains, it is evergreen), Mango, Orange, Pipal, Citrus, Goolar etc., (ii) In Deciduous plants—Ber, Semal, Devdar, Cheed, Pomegranate (Where winters are cold, this plant is deciduous).
- The world famous trade **'Aalsmear Flower Market'**, in Netherland is meant for the sale of cut-flowers, especially the rose varieties, wherein the rose varieties—'Hybrid-Tea' and Floribunda are being sold.
- In rose; the varieties of 'Hybrid Tea' are; Sonia Myland, Ilona, Bakera, Olasmeyer Gold, Red Success, Carlita and White Master Piece; and in **Floribunda** rose varieties—Golden times, Ever Gold, Geeza, Carona and Sabreena.
- Rose Day—25 June celebrated.
- In India, major flower markets are; Delhi, Gohati, Ahmedabad, Solan, Allahabad, Varanasi, Ludhiana, Mumbai, Bangalore, Chennai etc.
- In European countries, the respective choice and priorities of consumers towards flowers are as,
  **In England**—Carnation (white), Chrysanthemum, Rose (Pink), Tulip.
  **In France**—Rose (white), Chrysanthemum.
  **In Netherland**—Chrysanthemum, Rose, Carnation,
  **In Switzerland**—Rose (Red), Chrysanthemum, Carnation, Tulip (respectively)
- **In water plants**—Water Lilies; **In water logged soils/lands**—Acorus, Zenia, **in Ornamental water (hydro) grasses**—Hydro morphic Weeds—Pistia, Utricularia and Iris.
- In ornamental gardening, small plants, bricks, stones, bottles are used to separate flower beds from lawn; this practice is called **'Edging'**.
- In **'Edging'**—living plants are grown, such as Coleous, Caladium, Justicia, Peelia, Dwarf Marigold, Brachycom, Sweet Allyssum, Candituft, Flox etc., whereas in non-living (mechanical) methods—bricks, stones etc. are considered.
- **Origin-place of flower plants**—African Daisy (Aretotis)—South Africa; Calendula (Calendula officinalis)—South Europe; Cocks comb (Celosia argentea/C. plumosa)—Tropical Asia; Sweet Allyssum (Allyssum maritimum)-Europe/West Asia; Wall Flower (Cheiranthus cheiri)-Europe; Larkspur (Delphinium ajacis/D. consolida)-South Europe; Sweet William (Dianthus barbatus)—North France; Sweet Pea (Lathyrus odoratus)—South Europe; Hollyhock (Althaea rosea)—China; Sweet Sultan (Centaurea moschata)—Europe Antirhynum—South Africa and Mexican Aster (Cosmos bipinnatus)—Mexico.
- **Topiary**—That art of pruning & Training, wherein shrubs, small plants and at time herbacious perennial plants are changed into ornamental/or turninto any shape (like camel, elephant, peacock etc.). These can be seen in city parks/orchards. Kamla Nehru Park in Mumbai is famous for **'Topiary'**.
- **Flower exports from India (crore Rs.)**—301 (2005-06), 653 (2006-07), 340 (2007-08), 369 (2008-09) and 201 (April-Nov. 09).

## (iv) Vegetable Science (Olericulture)

- **'Olericulture'**—is a **'Latin'** word.
- **'SUN-GROW-496'** is a hybrid of tomato.
- **'PBOG-1'** A long fruit bottlegourd (Lauki) hybrid, developed from Pantnagar.
- Radish, Tomato and Chilli contain Vit. 'C' in enough quantity.
- Cauliflower (a Latin word) means—Caulis = Cabbage + Floris = flower; the cauliflower is a **Cole** crop. The cole crop comprising to cauliflower, cabbage and Knol-Khol.
- In cauliflower, buttoning is due to the deficiency of nitrogen.
- The pungency in Chilli is due the presence of active constituent **'Capsaicin'** alkaloid ($C_{18}H_2O_3N$ with 64·5-65°F).
- The red colour in tomato is due to **'Lycopin'** pigment, formed at 20-25°C temperature.
- Sweet-potato is a short day plant.
- Male sterility is found in Onion, Carrot and Tomato.
- Onion, Garlic, Arvi (Colocasia) and Yam are monocolyledon Vegetables.
- For breaking dormancy of Potato tubers, thiorea is used.
- Tristeza Virus is spread due to aphids.
- **'Pusa Jwala'** Chilli is a cross of NP-46-A × Pusa Red.
- For commercial crop production of tomato, the growth regulators *viz*. NAA (30 ppm) and GA(20 ppm) are used as spray, resulting there by higher crop yield.
- **'Ricyness'** in cauliflower develops due to application of excess nitrogen and higher relative humidity.
- The yellow colour in onion is developed through CCrr genotype.
- **'Cardamom'** is said to be the **'Queen of Spices'**.
- Pumpkin Day celebrated on—29 Sept. in Germany, 320 kg weight of a pumpkin/Kaddu was recorded highest in world and in England 'Kheera' say—Cucumber length was 43 inches largest in world.
- 'Hydroponics' is a **'Greek'** word and related to without land cultivation *i.e*. crop cultivation in water *e.g*. waternut (Singhada).
- The seeds of synthetic varieties are changed after every 5-6 years.
- The seeds of hybrids (varieties) of crops are purchased by the farmers every year.
- The crop of tomato has the quality of both thermo and photo-sensitive.
- The dehydration ratio in potato is 7 : 1.
- The dry ratio in **Okra** (Lady finger) is 12 : 1.
- Sugarbeet is hexaploid.
- 'Whip-tail' disease in cauliflower is caused due to the deficiency of molybdenum (Mo).
- 'Browning' disease in cauliflower is caused due to the deficiency of boron (Bo).
- Pungency in onion is due to the presence of Allyle Propyl di-sulphide.
- 'Mosaic' in potato is caused due to virus.
- Seed treatment through **'Bavistin'** controls effectively the seed borne diseases in crops.
- The word **'curd'** is related to cauliflower, wherein the colour of head becomes curdy white.
- 'Azad Nutan' is a variety of Bottle-gourd.
- 100 g fresh carrot contains approx 3150 (IU) Vit 'A'.
- Vit. 'A' is abundently found in green leafy vegetables.
- All vegetables have generally more or less all vitamins.
- Night-blindness in human is caused due to deficiency of Vit. 'A'.
- Onion (green/bulbs) is the best source of Vit. 'B'.
- The best sources of **'Fe'** (iron) are—carrot, bittergourd, onion and tomato.
- Nearly 285 g vegetables per day per capita in human diet for body is recommended.
- Cauliflower is sensitive for excess of acidity of soil.
- Cauliflower requires more boron (Bo) and molybdenum (Mo).
- Cabbage requires more plant nutrients (*i.e*. heavy feeder) particularly the N and K nutrients in excess amount.
- The seed rate of Knolknol (Ganthgobhi) in nursery is maintained about 1250 g for one hectare transplanting.
- Ripened tomato contains about 94% water, which is more suitable for good source of Vit. 'C'; Vit 'A' and Vit. 'B'.
- Cucumber is the oldest cultivated vegetable crop; which is possibly originated from India.
- The weevil (Cylas formicarius) is most serious insect of Sweet potato.

- Internal break-down is occured in cold storage at—1°C to - 0 degree celsius (°C) of potato tubers, resulting into 'black heart' disease in potato.
- **'Heart rot'** disease in sugarbeet is caused due to deficiency of boron.
- **'Brown heart'** disease in turnip is caused due to deficiency of boron.
- The 'Scion' of tomato produces poisonous fruit, if grafted on **Datura (Datura stramonium)**.
- The seedless fruits in tomato are developed through **'Parthenocarpy'**.
- Potato tuber contains Vit 'B' and Vit. 'C' and for Papad/Chips-Kufri Chipsona 1, 2 & 3.
- **'Potato' Called as 'A wholesome Food'** per 100 gram potato contains 16 g carbohydrate, 2g protein, 1 g minerals, 0·1g fat, 0·03 g vit. 'C' and 0·02 g vit. 'B'.
- For breaking the dormancy of potato tubers, the use of $GA_1$ at 40 ppm and thiorea (1%) solution as seed treatment.
- **'Pusa-120'**—a variety of tomato is developed for the first time, which is resistant to root-knot nematode.
- **'Arka Vishal' Arka Shreshta, Arka Abhijit** and **'Arka Vardan'** are the varieties of tomato.
- **'Arka Abha'** and **'Arka Alok'** varieties of tomato are tolerant against low moisture in soil and also resistant to wilt (bacterial wilt).
- **'Pusa Kiran'** (**Kharif** season—July to October) and **'Pusa Kirti'** (Summer season—March to June) varieties of **Chaulai** (Amaranth).
- **'Arka Anamika'** and **'Parbhani Kranti'** are the varieties of **Okra**.
- In North India **'Sugar Baby'** and in South States **'Arka Manik'** varieties of watermelon are cultivated for commercial production.
- **'Shree Vishakham'** (H-1687) and **'Shree Prakash'** (S-856) are the varieties of **tapioca** (cassava).
- **'Shree Kirti'** and **'Shree Roopa'** are the varieties of **Yam** (Rataloo).
- **'Sree Nandini'**, **Sree Arun, Sree Varun 'Varsha'**, **'White Star'**, **'Sree Vardhani'**, **'Kiran'** and **'Kalmegh'** are the varieties of Sweet potato.
- **'Kufri Navtal'**, **'Kufri Navjyoti'**, **'Kufri Himalini'**, **'Kufri Sherpa'**, and **'Kufri Anand'** are the varieties of potato.
- Varsha, Vijaya, Vishal, Panchali, Adhunik, Sun-Grow-35, Pusa Savani and Kashi and Parbhani Kranti are the varieties of **Okra** (Bhindi).
- Some hybrids of Chillies, have been developed *viz*. Agni and Indira of Sandoz, Hybrid-1 from Research Station Katrain of IARI and **'Tejashwani'** of Mahyco.
- Varieties of Shimla Mirch (Chilli), which have been released recently are; Arka Mohini, Arka Gaurav, Arka Basant and Hybrid Bharat.
- Shimla Mirch, those are less pungent, said to be the **'Bell Pepper'**.
- The major varieties of less pungent Chillies are; Bullnose, California Wonder, King of North, Ruby King and Sweet Banana.
- The Pea variety **'Hisar Harit-1'** (PH-1) is the cross of (between) Bonneville × Pea 23.
- Frenchbean varieties are; Tender Green, Prider and IIHR-434.
- Brinjal varieties recently developed from IARI are; Pusa Anmol, Pusa Bhairav and Pusa Hybrid-5.
- Telephone, New Line Perfection and Arkel are the recent varieties of pea.
- The Onion varieties developed from IIHR Bangalore are; Arka Kalyan, Arka Niketan, Arka Pragati, Arka Bindu, Arka Kirtiman Arka Pitamber, Arka Bheem and Arka Swadista.
- Sugarbeet varieties are; Crimson Glove, Father ball, Pusa Kanchan, and Mahyco Red.
- The important varieties of Turnip are—Pusa Chandrima, Pusa Kanchan, Pusa Swarnima, Purple top, Pusa Sweti and Golden Ball.
- Recently developed varieties of Carrot are; Pusa Keshar, Pusa Meghali, Pusa Yamdagni and Selection-233.
- The Black Pepper varieties are; Panniyr-1,2,3, 4 and 5; Subhakara, Shree Kara, Panchmi etc.
- Mudigere-1, ICRI-1, 2, 3 and 4 are the important varieties of Small Cardamom.
- The varieties of Ginger are; Suprabha and Surbhi.
- The varieties of *Turmeric* are; Krishna, Sugandhum, Sudarshan, IISR-Prabha and Pratibha.

- The **'Coriander'** (dhania) varieties are; Hissar Anand, Sindhu, Gujarat Dhania-1.
- Sonf (Fennel) varieties are; Gujarat Sonf-1 and 2.
- Cumin (Jeera) varieties are; Gujarat-1 and 2.
- The varieties of Fenugreek—**'Hissar Sonali'** and **'CO-1'** are considered better.
- **'India'** is the origin place of; Clusterbean (Guar), Bean, Cucumber, Muskmelon, **Kakoti** (Kakri or Snake Cucumber), Ridged/Ribbed Sponge gourd (Nasdar Torai), Parwal, Chichinda, Kundru, Brinjal, Palak, Chaulai, Zimikand and Turmeric.
- Newly released varieties of vegetables—**Cowpea**—IVRCP-1, काशी उन्नत; **Chilli** hybrids—MSH-96, MSH—172; **Bottle-gourd**—Pusa Samridhi; **Onion**—Bhima Raj (red), **Palak**—Arka Anupurna, **Potato** hybrids—MP/99-406, Hybrid J-93-86 and MP/99-322, Tomato hybrid—TLBRH-9, Hybrid 70; OKra-Hybrid OH-5, Arka Samrat.

## (v) Important Medicinal and Aromatic Plants

**Newly released varieties**—

- **Ashwagandha**—MWS-131, MWS-212, MWS-133, IIHR-WS-3.
- **Safed Musli**—NRCCB-1 and 2, MCB, RC-77.
- **Opium poppy**—NOP-02-3, NOP-02-9.
- **Isabgol**—Genotype GI-2.
- **Kalmegh**—IC-342139.
- **Satavari**—HAR-8
- **Lemongrass**—OD-19, CKP-25
- **Palmarosa**—RH-03-43
- **Chandrasur**—MLS-1
- **Mentha**—Selection HMA-1
- **Mandukparni (Centrella asiatica)**—Vallabh Medha.

## Other

- In Agra, an Orchard/garden known (now) as—**'RAMBAGH'**, Earlier name—**'AARAM BAGH'** was planted/constructed by king **'Babar'** in 1526 A.D. for his own rest, to realize comfort, After his (Babar) death, he was burried here and later on, his dead body (Lash/Taboot) was taken away in a garden of **Kabul** (Afganishtan), that was liked most by Babar.
- According to **Vatsayan** (300-400 A.D.), gardens are of four types; **'Nandanvan'**, **'Udhyan'**, **'Brachh Batika'** and **'Pramodou-dhyan'**.
- In Kashmir, near Dul Lake, Great Mughal Emperor **'Akbar'** established the **'Naseem Bagh'**.
- 'Lal Bagh Garden' is located at Bangalore.
- **Moriculture**—Growing mulberry (Shahtoot) plants for rearing of silk insect, which is related to **'Sericulture'**. Silk Industry in Karnataka is on frontline.
- National Research Centre on Medicinal and Aromatic Plants (NRC-MAP) Anand (Gujarat) is conducting research on aromatic & medi-cinal plants under ICAR.
- Nehru Memorial Botanical Garden is located at Chesmashahi (J & K).
- Mughal Emperor Jahangir, in the year 1619 A.D., constructed the Shalimar Mughal Garden at Shrinagar; and after 11 years, the re-extension was made by the then Governor (J & K)—Kasim Jaffar Khan.
- Mughal Garden **'Nishat'** was constructed by Asaf Khan (The brother of Noorjahan w/o Jahangir) in the year 1632 A.D.
- Project Co-ordinator Offices are meant for; (i) **Sub-tropical fruits**—CIHNP, Lucknow; (ii) **Arid Fruits**—CCSHAU, Hisar; (iii) **Potato**—CPRI, Shimla; (iv) **Regional Office of Tuber Crops**—(CTCRI)—Bhuva-neshwar; (v) **Mushroom**—NCMRT, Solan; (vi) **Aromatics & Medicinal Plants**—NBPGR, New Delhi; (vii) **Palm**—CPCRI, Kasargod (Kerala); (viii) **Spices**—NRC-S, Calicut (Kerala); and (ix) **Cashew**—NRCC, Puttur (Karnataka).
- **NHM** (National Horticulture Mission) set-up on 5 May, 2005 and **NHB** (National Horticulture Board) Gurgaon (Haryana) founded in 1984.
- **References/Books related to vegetables**—Vegetable Production in India—Dr. D.V.S. Chauhan; Vegetables—B. Choudhury; Vege-table Crops—Thompson & Kelley; Vegetable Crops of India—K.S. Yawalkar and Vegetable Growing in Northern India-S.S. Purewal.
- **Major Gardens**—'Taj Garden (Agra); Ram-bagh (Agra); Municiple Park (Mussoorie); Pinjor Garden (Pinjor); Motibagh (Patiala), Nasimbagh and Shalimar (Kashmir; Talkatora Garden – Delhi).

## Important Potato Varieties

| Variety | Cross/Parents | Year of Release | Duration (Days) |
|---|---|---|---|
| Kufri Chandramukhi | Seedling 4485 × Kufri Kuber | 1968 | Early-(80-90 days) |
| K. Anand | PJ-376 × PH/F-1430 | 1999 | Medium (100-110) |
| K. Ashoka | EM/C-1020 × Allerfriifieste Gulbe | 1996 | Early (70-80) |
| K. Badshah | K. Jyoti × K. Alankar | 1979 | Medium (100-110) |
| K. Bahar (E-3797) | Kufri Red × Gineke | 1980 | Medium (100-110) |
| K. Chipsona-1 | MEX-750826 × Ms/78-79 | 1998 | Medium (90-110) |
| K. Chipsona-2 | F-6 × QB/B 92-4 | 1998 | Medium (90-110) |
| K. Giriraj | SLB-132 × EX/A 680-16 | 1998 | Medium (130-135) |
| K. Jawahar | K. Neelamani × K. Jyoti | 1996 | Early (80-90) |
| K. Jyoti | [3069 d(4) × 2814 a(1)] | 1968 | Mid-early (90-1120) |
| K. Lalima | Kufri Red × AG-14 (Wise × 37) | 1982 | Medium (100-110) |
| K. Laukar | Adina × Sarkov | 1972 | Early (75-80) |
| K. Pukhraj | Craig's Defiance × JEX/B-687 | 1998 | Early (70-90) |
| K. Sindhuri | K. Red × K. Kundan | 1967 | Tale (110-120) |
| K. Sutlej | K. Bahar × K. Alankar | 1996 | Medium (100-110) |
| K. Swarna | K. Jyoti × $(VTn)^2$ 62·33·3 | 1985 | Medium (100-110) |

(International Year of Potato-2008 was celebrated) (In 2009 Two potato hybrids—Kufri Nilima & Kufri Frysona—identified for release.)

## *Multiple Choice Questions*

1. Match the following with each other—

**Vegetative Propagation**

(a) Cleft grafting
(b) Bridge grafting
(c) Common method of propagation in mango and loquot
(d) One popular method of budding in Mango in Indonesia, now also is recommended in India

**Objective**

1. Especially suited for top worked tree
2. From repairs point of view
3. Forkert method
4. Inarching

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 1 | 2 | 4 | 3 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 3 | 1 | 4 | 2 |

2. Which group is not matched ?
(A) Pomology — Fruit Science
(B) Floriculture — Flower Science
(C) Olericulture — Vegetable Science
(D) Pisciculture — Forest Science

3. Which is correct in propagation through suckers in banana ?
(A) Underground stem
(B) Underground corm
(C) Stolen
(D) Pseudo stem

4. Which fruit plant is more suitable for tropical climate of coastal area ?
(A) Coconut (B) Date palm
(C) Walnut (D) Phalsa

5. Which group is related to cut-flowers use—
(A) Rose, Panzi, Galardia and Petunia
(B) Rose, Carnation, Marigold and Porchulaca
(C) Rose, Gladiolus, Marigold and Tuberose
(D) Aster, Gladiolus, Rice-plant and Jasmine (Chameli)

6. Match the following—

| Plants | Vegetative Propagation |
|---|---|
| (a) Canna | 1. Bud |
| (b) Gladiodus | 2. Rhizome |
| (c) Rose | 3. Tuber |
| (d) Dahelia | 4. Corm |

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 4 | 1 | 3 |
| (C) | 3 | 1 | 2 | 4 |
| (D) | 4 | 1 | 2 | 3 |

7. Which of the group is related to self-pollinated vegetables ?
   (A) Pea, Okra, Potato and Chilli
   (B) Cucumber, Potato, Radish and Sugarbeet
   (C) Sugarbeet, Cauliflower, Pea and Lobia
   (D) Carrot, Garlic, Okra and Tomato

8. Which group is true related ?
   (A) Carrot — Solanaceae
   (B) Lobia — Liliaceae
   (C) Potato — Solanaceae
   (D) Cucumber — Malvaceae

9. The upper stem of banana is called—
   (A) Rhizome
   (B) Suckers
   (C) Pseudo-stem
   (D) None of these

10. The suitable time of banana planting is—
    (A) October
    (B) December
    (C) June-July
    (D) January-February

11. The filler-plant (tree) in mango orchard is—
    (A) Apple (B) Adoo
    (C) Alucha (D) Papaya

12. Which is called the **'King of Fruits'** ?
    (A) Pomegranate (B) Apple
    (C) Banana (D) Mango

13. Which of the mango variety (Hybrid) is developed from the cross of Neelum (♂) × Dashehari (♀) ?
    (A) Amrapali
    (B) Langara
    (C) Mallika
    (D) Sindhu

14. Which of the mango hybrid is developed from the cross of Dashehari (♂) × Neelum (♀) ?
    (A) Mallika
    (B) Amrapali
    (C) Neeleshwari
    (D) Arka Puneet

15. The hybrid mango developed from the cross of Neelum × Alphonso is—
    (A) Langara
    (B) Ratna
    (C) Arka Anmol
    (D) Manjeera

16. 'Grafted' Mango becomes ready for trans-planting—
    (A) Early (B) Late
    (C) Very late (D) Never

17. For planting in mango; the recommended Row × Row and Plant to Plant spacing is—
    (A) 10 m (B) 15 m
    (C) 20 m (D) 5 m

18. In hybrid variety of Mango—**'Amrapali'**, the Row × Plant spacing is generally kept—
    (A) 10 meter
    (B) 2·5 meter
    (C) 5 meter
    (D) 15 meter

19. Generally, alternate bearing problem is noticed in fruit trees—
    (A) Apple (B) Ber
    (C) Mango (D) Guava

20. Fruit dropping in mango can be controlled by the spraying of—
    (A) 2, 4 - D
    (B) Potassium Chloride
    (C) Urea
    (D) None of these

21. **'Musa paradisiaca'** is the botanical name of—
    (A) Guava (B) Apple
    (C) Pineapple (D) Banana

22. The planting spacing (Plant × Row) in banana is kept—
(A) 3 × 3 m (B) 5 × 5 m
(C) 10 × 10 m (D) None of these

23. Which plant gives fruits only once in life ?
(A) Mango (B) Banana
(C) Phalsa (D) Papaya

24. Which one is not the variety of banana—
(A) Mauritius (B) Poovan
(C) Sardar (L-49) (D) Lal Velchi

25. Guava **'Hybrid-45'** is the cross of—
(A) Allahabadi Safeda × Seedless
(B) Allahabadi Safeda × L-45
(C) Apple Colour × Allahabadi Safeda
(D) None of these

26. **'Loquat'** is the origin of the country—
(A) Mid China (B) India
(C) South America (D) Sri Lanka

27. For pollination in **Papaya** orchard, the number (in per cent) of male plants must be present—
(A) 5 – 10% (B) 20 – 25%
(C) 50 – 60% (D) Zero

28. The latest (modern) method of propagation of **'Guava'** is—
(A) Stooling (B) Inarching
(C) Budding (D) Air layering

29. The recommended Plant × Row spacing in **'Guava'** is—
(A) 2 × 2 m (B) 5 × 5 m
(C) 8 - 10 × 8 - 10 m (D) 4 × 4 m

30. Which nitrogenous (N) fertilizer is considered suitable for **'Pine-apple'** ?
(A) Ammonium Sulphate
(B) Urea
(C) C.A.N.
(D) None of these

31. In India, **'Sapota'** tree comes in fruiting—
(A) One in a year (B) After two years
(C) Twice in a year (D) Thrice in a year

32. How many plants (approximately) are required for planting one hectare **'Cheeku'** (Sapota)—
(A) 120 (B) 200
(C) 300 (D) 400 and above

33. Vegetative propagation in **'Apple'** is meant through—
(A) By Root-cutting
(B) By Seeds
(C) Only 'T' (or Shield) Budding
(D) 'T' (Shield) Budding and Bench (or tongue grafting)

34. Match the following—

**Fruit**
(a) Cherry
(b) Apple
(c) Khuvani (Apricot)
(d) Litchi

**Suitable Method of Vegetative Propagation**
1. Whip or tongue grafting
2. Shield Budding
3. Shield Budding & Tongue grafting
4. Goottee

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 2 | 3 | 4 | 1 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 1 | 3 | 2 | 4 |
| (D) | 4 | 3 | 2 | 1 |

35. Match the following—

**Fruit**
(a) Cashew
(b) Loquat
(c) Strawberry
(d) Pomegranate

**Botanical Name**
1. Eriobotrya japonica
2. Anacardium occidentale
3. Punica granatum
4. Fragaria spp.

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 3 | 4 | 1 | 2 |
| (B) | 4 | 1 | 3 | 2 |
| (C) | 2 | 1 | 4 | 3 |
| (D) | 2 | 3 | 1 | 4 |

36. Match the following—

| **Fruit** | **Botanical Name** |
|---|---|
| (a) Plum | 1. Prunus avium |
| (b) Pear | 2. Prunus persica |
| (c) Peach | 3. Pyrus communis |
| (d) Cherry | 4. Prunus domestica |

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 3 | 2 | 1 |
| (C) | 2 | 3 | 1 | 4 |
| (D) | 3 | 1 | 2 | 4 |

37. Which one is not matched ?

| | **Fruit** | **Botanical Name** |
|---|---|---|
| (A) | Apricot | 1. Prunus armeniaca |
| (B) | Apple | 2. Pyrus malus |
| (C) | Fig | 3. Phyllanthus emblica |
| (D) | Ber | 4. Ziziphus mauritiana |

38. Match the following—

**Fruit**

(a) Aonla
(b) Phalsa
(c) Jackfruit
(d) Avocado

**Vegetative Propagation**

1. Phyllanthus emblica
2. Grewia asiatica
3. Artocarpus heterophyllus
4. Persea spp.

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 3 | 4 | 1 |
| (C) | 3 | 2 | 1 | 4 |
| (D) | 4 | 2 | 3 | 1 |

39. Which of the following disease is caused due to deficiency of Vit. 'B' ?

(A) Beriberi (B) Nightblindness
(C) Scurvy (D) Jaundice

40. Match the following—

| | **Crop** | **Origin Place** |
|---|---|---|
| (a) | Cauliflower | 1. Asia |
| (b) | Onion | 2. South America |
| (c) | Watermelon | 3. Africa |
| (d) | Muskmelon | 4. India |

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 1 | 2 | 3 |
| (C) | 2 | 1 | 3 | 4 |
| (D) | 3 | 1 | 4 | 2 |

41. Which one is not matched ?

| | **Crop** | **Origin Place** |
|---|---|---|
| (A) | Pea | Ethopia |
| (B) | Brinjal | India |
| (C) | Snake Cucumber (Kakri) | Australia |
| (D) | Snake Cucumber (Kakri) | India |

42. Which one is not matched ?

| | **Crops** | **Variety** |
|---|---|---|
| (A) | Tomato | Hisar Lalit |
| (B) | Cucumber (Kheera) | Hisar Madhur |
| (C) | Bottle gourd (Lauki) | Pusa Sandesh |
| (D) | Bitter gourd (Karela) | Pusa Vikash |

43. Match the following—

| | **Crops** | **Variety** |
|---|---|---|
| (a) | Tomato | 1. Hisar Lalima |
| (b) | Carrot | 2. Hisar Gairic |
| (c) | Cucurbit | 3. Pusa Vikas |
| (d) | Watermelon | 4. Arka Manik |

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 3 | 1 | 2 | 4 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 2 | 3 | 1 | 4 |
| (D) | 4 | 1 | 2 | 3 |

44. Which one is not matched ?

| | **Variety** | **Developed by the Centre** |
|---|---|---|
| (A) | Hybrid Brinjal variety **'Arka Navneet'** | IIHR, Bangalore |
| (B) | Hybrid Brinjal **'Azad hybrid'** and **'Kalyanpur Vijay'** | C.S.A.U.A.T., Kanpur |
| (C) | **'Pant Brinjal'** | NDUAT, Faizabad |
| (D) | **'Kalptaru'** and **'MHB–1'** Hybrid Brinjal | Mahyco |

45. Match the following—

**Crops**

(a) Bitter gourd *(Karela)*
(b) Tomato
(c) Sponge gourd *(Torai)*
(d) Muskmelon *(Kharbooj)*

**Hybrid/Varieties**

1. Century — Tijarati, Mahyco - Long Green, Arka Harit & Pusa Do-mosami
2. Rajni, Roopali, Sonali, Mangla and Arka Vardan
3. Utsav (Century), Harita, Rohini and Surekha
4. Punjab Hybrid, Pusa Rasraj, Swarna, Sona and Madhuvala

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 3 | 1 | 2 | 4 |
| (B) | 4 | 1 | 2 | 3 |
| (C) | 1 | 2 | 3 | 4 |
| (D) | 2 | 1 | 3 | 4 |

46. Match the following—

**Tuber Crops**

(a) Zimikand (Elephant Foot-Yam)
(b) Rataloo (Yam)
(c) Shakarkand (Sweet Potato)
(d) Tapioca (Cassava)

**Botanical Name**

1. Dioscorea alata
2. Amorphophallus camponulatus
3. Manihot esculenta
4. Ipomoea batatas

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 1 | 4 | 3 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 3 | 1 | 2 | 4 |

47. Match the following—

**Tuber Crops**

(a) Potato
(b) Sweet Potato
(c) Tapioca
(d) Arvi (Elephant ear) and Zimikand (Elephant Foot-Yam)

**Family**

1. Convolvulaceae
2. Euphorbiaceae
3. Araceae
4. Solanaceae

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 4 | 1 | 2 | 3 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 4 | 2 | 1 | 3 |
| (D) | 3 | 1 | 2 | 4 |

48. Select True/False group—

| | **Salad Crops** | **Botanical Name** |
|---|---|---|
| 1. | Lettuce | Lactuca sative |
| 2. | Celery | Apium graveolens |
| 3. | Parsley | Petroselinum crispum |

**Code :**

(A) Only (1) true & others — false
(B) Only (2) true & others — false
(C) All (1), (2) and (3) — true
(D) None is true

49. Select the false group—

| | **Salad Crops** | **Family** |
|---|---|---|
| (A) | Parsley | Umbelliferae |
| (B) | Celery | Compositae |
| (C) | Salad (lettuce) | Asteraceae |
| (D) | New Zealand Spinach | Izocaceae |

50. Match the following—

**Spices Crops**

(a) Ginger
(b) Turmeric
(c) Coriander
(d) Azawain

**Botanical Name & Family**

1. Trachyspurmum amini (Umbelliferae)
2. Zingiber officianale (Zingiberaceae)
3. Curcuma longa (Zingiberaceae)
4. Coriandrum sativum (Umbelliferae)

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 3 | 1 | 2 | 4 |
| (B) | 2 | 3 | 4 | 1 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 3 | 4 | 2 | 1 |

51. Match the following—

**Crops**

(a) Turmeric, **Zimikand** and **Chaulai**
(b) Coriander, **Zeera,** Onion and Garlic
(c) Peas
(d) Tomato

**Origin Place**

1. India
2. Bhoomadhya Sagariya Areas
3. Ethopea
4. Peru & Mexico

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 4 | 2 | 3 | 1 |
| (B) | 2 | 1 | 3 | 4 |
| (C) | 1 | 2 | 3 | 4 |
| (D) | 4 | 3 | 2 | 1 |

52. Which of the following in not matched ?

| **Fruit Trees** | **Botanical Name & Family** |
|---|---|
| (A) Mango | Mangifera indica (Anacardiaceae) |
| (B) Guava | Psidium guajava (Myrtaceae) |
| (C) Aonla | Phyllanthus emblica (Euphorbiaceae) |
| (D) Ber | Carica papaya (Caricaceae) |

53. Match the following—

**Aromatic Flower Group**

(a) Rose, Mogra & Gandhraj
(b) Rajnigandha (tuberose), Chandni & Menhdi
(c) Rukmini
(d) Kadamb, Passion Flower & Hara Champa

**Flowering time/season**

1. Through out the year
2. Autumn (Basant), Summer & Rainy
3. Summer
4. Rainy

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 1 | 3 | 4 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 3 | 1 | 2 | 4 |

54. Match the following—

**Aromatic Flower Group**

(a) Mogra, Rose, Joohi, Karonda & Rat-ki-Rani
(b) Kadumb & Madhavi Lata
(c) Passion Flower, Champa & Har Shringar
(d) Rajnigandha (Tuberose)

**Propagation Method**

1. Cutting
2. Seeds
3. Goottee
4. Bulb/Tuber

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 4 | 3 | 1 | 2 |
| (B) | 3 | 4 | 1 | 2 |
| (C) | 1 | 2 | 3 | 4 |
| (D) | 2 | 3 | 4 | 1 |

55. Which of the following is not matched ?
(A) Chrysanthemum Society of India — New Delhi
(B) Bombay Rose Society — New Delhi
(C) National Cactus & Succulents Society of India — Chandigarh
(D) Agri-Horti Society of India — Kolkata

56. Match the following—

**Flower type**

(a) Rose & Gladiolus
(b) Orchids
(c) Carnation
(d) Aster

**Recommended Temp (°C) for Storage period**

1. 1·7 — 4·4 (6-9 days)
2. 5·0 — 7·0 (14-15 days)
3. 0 — 2·2 (15 days)
4. 4·4 (in water) (5 days)

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 3 | 1 | 2 | 4 |
| (C) | 2 | 1 | 3 | 4 |
| (D) | 4 | 1 | 3 | 2 |

57. Which of the garden is not matched ?
(A) Taj Garden — Delhi
(B) Rock Garden — Chandigarh
(C) Baradari Garden — Patiala
(D) Shalimar Bagh — Shrinagar

58. Style of ornamentaling gardening is divided into how many parts ?
(A) Formal style, only
(B) Informal style, only
(C) Free style, only
(D) All above

59. Major components of garden are—
(A) Fencing
(B) Edging
(C) Flower, Greenary, Lawn, Branches
(D) All Fencing, Edging, Greenary, Lawn, Branches

60. Match the following—

**Flower Plants**

(a) Blanket Flower (Gaillardia pulchella)
(b) Backelor's Button (Gamphrena globosa)
(c) Sweet Pea (Lathyrus odoratus)
(d) Petunia (Petunia hybrida)

**Origin Place**

1. India
2. America
3. Italy
4. South America

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 3 | 1 | 2 | 4 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 2 | 1 | 3 | 4 |

61. Which is not matched ?

| | **Flower Plants** | **Origin Place** |
|---|---|---|
| (A) | Hollyhock | China |
| (B) | Sweet Allysum | Europe, West Asia |
| (C) | African Dazy | South Africa |
| (D) | Mexican Aster | India |

62. Match the following—

| | **Fruit Trees** | **Origin Place** |
|---|---|---|
| (a) | Loquat | 1. Japan & China |
| (b) | Mango | 2. Malaya |
| (c) | Apple | 3. South-West Asia |
| (d) | Peach & Litchi | 4. China |

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 1 | 2 | 3 |
| (C) | 3 | 1 | 2 | 4 |
| (D) | 2 | 3 | 1 | 4 |

63. Which of the pair is not matched ?

| | **Fruit Trees** | **Origin Place** |
|---|---|---|
| (A) | Plum | North America & Japan |
| (B) | Apricot | Armenia |
| (C) | Passion Fruit | Brazil |
| (D) | Litchi | India |

64. Match the following—

**Fruit Trees**

(a) Strawberry
(b) Mulberry
(c) Indian Blackberry (Jamun)
(d) Hazlenut

**Botanical Name & Family**

1. Fragaria Species (Rosaceae)
2. Morus Species (Moraceae)
3. Syzygium cumuni (Myrtaceae)
4. Corylus avellana (Bitulaceae)

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 3 | 4 | 1 | 2 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 2 | 3 | 1 | 4 |
| (D) | 4 | 3 | 1 | 2 |

65. Which group is false ?

| | **Fruits** | **Edible Part** |
|---|---|---|
| (A) | Guava | Thalamus & Pericarp |
| (B) | Grape | Pericarp & Placenta |
| (C) | Litchi | Seed |
| (D) | Pomegranate | Seed-coat's external juicy part |

66. Which statement is false ?

| | **Fruits** | **Edible Part** |
|---|---|---|
| (A) | Litchi | Fleshy Aril |
| (B) | Mango, Papaya | Mesocarp |
| (C) | Tomato | Pericarp & Placenta |
| (D) | Mango | Endocarp |

67. Which is not matched ?

| | **Fruits** | **Edible Part** |
|---|---|---|
| (A) | Coconut | Endosperm |
| (B) | Fig | Fleshy recepticle |
| (C) | Cucumber (Kheera) | Mesocarp, Endocarp & Placenta |
| (D) | Date-palm | Endocarp |

68. Which group is not matched ?

| | **Trees** | **Longevity (Age)** |
|---|---|---|
| (A) | Strawberry | 20 - 30 years |
| (B) | Pomegranate, Plum, Pear | 20 - 40 years |
| (C) | Fig | 50 - 100 years |
| (D) | Sweet Chest-nut | 1000 years |

69. Match the following—

**Flower crops**

(a) Bougainvillea
(b) Gurhal (Hibiscus)
(c) Gladiolus
(d) Chrysanthemum

**Commercial Varieties**

1. Wazid Ali Shah & Arjun
2. Bharat Sundari & Dilruba
3. Najrana & Oscar
4. Birbal Sahani & Chandra Kanta

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 3 | 4 | 1 | 2 |
| (B) | 1 | 2 | 3 | 4 |
| (C) | 2 | 3 | 1 | 4 |
| (D) | 4 | 2 | 3 | 1 |

70. Match the following—

**Aromatic Plant**

(a) Khus (Vetiver)
(b) Rose
(c) Palmarosa
(d) Lemon grass

**Commercial Varieties**

1. Sugandha
2. Motia
3. Pusa Gaurav
4. LS-48

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 1 | 2 | 3 |
| (C) | 1 | 3 | 2 | 4 |
| (D) | 3 | 1 | 4 | 2 |

71. Lantana (Lantana camera), a origin from Jamaica, belongs to the family—

(A) Vervenaceae (B) Rosaceae
(C) Acanthaceae (D) Luthraceae

72. Which type of flower-arrangement (beautification) is exhibited by 'Moribana' (or 'Piled Flowers') ?

(A) Shallow Containers
(B) Deep Containers
(C) Paper Cones
(D) Paper Wrapping

73. Which of the following is beneficial for the treatment of diabetic disease in human being?

(A) Jamun (Indian Blackberry)
(B) Mango
(C) Citrus
(D) Bael

74. European Patent in **'Cassava'** is provided to such a technology, for which the affiliation has been given by the ICAR and NRDC—

(A) For justified successfulness in development of starch based bio-degradable plastic of cassava
(B) For technique to change of starch to maltose in cassava
(C) For change of glucose to fructose in cassava
(D) None of these

75. Recently, a technique has been standardized in sweet-potato, which is—

(A) A technique to change of starch to maltose
(B) For change of glucose to fructose
(C) Change of fructose to sucrose
(D) None of these

76. **'Alphonso'** Mango can be stored for how many days, if in controlled atmosphere, 5% Oxygen ($O_2$) and 3-4% Carbon-di-Oxide ($CO_2$) are present ?

(A) 5 days
(B) 10 days
(C) 30 days
(D) For several months

## *Fill-up the Blanks*

1. Two fruits, wherein the maximum Vit. 'C' is present, those are (in descending order ) … and … .
2. Such two fruits crops, those have maximum area in India, those are … and …, respectively.
3. Two annual flowers, those are suitable for **'Hanging Basket'**; are … and ….
4. Two grasses suitable for **'lawn'**, have their botanical names; (B.N.) … (Grass Name) … and …—; respectively.
5. … are the methods of fruits and vegetables preservation.

6. The pungency in onion and garlic is due to … and …, respectively.
7. The failureness in fruits-setting are due to … and ….
8. The main causes of **'Brown rot'** and **'whip Tail'** in cauliflower are (respectively) due to … and ….
9. The main two methods of moisture conservation are … and ….
10. According to season, vegetables can be classified into … and ….
11. The 'auxins' was invented by the scientist … and in the year ….
12. … and … are considered in synthetic auxins.
13. There are two types of natural auxins—(i) … and (ii) ….
14. …, …, … and … (fruits) are considered in **'parthenocarpic'** fruits, wherein fruits are developed without pollination.
15. It is true that the auxins have greatest importance in parthenocarpic fruits that were known through the researches conducted by the scientist ….
16. ARS — Agricultural Research Services was started by the ICAR in the year ….
17. ASRB (Agricultural Scientists Recruitment Board) in ICAR was established in the year ….
18. National Horticulture Board (NHB) was established in the year ….
19. IIHR (Indian Institute for Horticultural Research), Bangalore was established in the year ….
20. CTRI—Central Tubercrop Research Institute, Tiruvananthpurum (Kerala) was established in the year … and CPCRI—Central Plantation Crop Research Institute, Kasargod (Kerala) was established in the year ….
21. 'Pumpkin Day' is celebrated on … .

## *Write—True and False*

1. Ascorbic Acid helps in initiation of adventitious roots. (…)
2. Mango, Papaya and Banana are the non-climacteric fruits. (…)
3. **'Thiorea'** is used to break dormancy. (…)
4. Orange, Grape and Mandarin are the non-climacteric fruits. (…)
5. 2, 4-D is used to control fruit-drop in mango. (…)
6. In tomato, the growth regulater-Gibberelic Acid (GA) is used @ 50 ppm. (…)
7. The use of Maleic Hydrozide—(MH) @ 50 ppm acts as growth regulator in bottlegourd and cucumber. (…)
8. The self-pollinated vegetables are—Methi (Fenugreek), Peas, Tomato and Brinjal. (…)
9. All cucurbits are considered in cross pollinated vegetables. (…)
10. **'Leaf Curl'** disease in Okra (Bhindi) is spread/caused due to white-fly. (…)
11. The word 'Gibberellin' was used for the first time by the scientist Yabuta in the year 1935. (…)
12. Yabuta and Sumik Scientists gave the name Gibberellin 'A' and 'B' in the year 1938. (…)
13. GA-1, GA-2, GA-3, GA-4 and GA-5 are considered in the series of Gibberellins. (…)
14. The development of parthenocarpic fruits in tomato, cucumber, brinjal and chilli are made by the use of Gibberellin. (…)
15. Presently (2008) horticultural crops occupy around 10% of gross cropped area of India, producing 160·75 million tonnes. (…)
16. 'National Horticulture Mission' (NHM) was launched from May 2005 in 10th Plan. (…)

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (B) | 2. (D) | 3. (A) | 4. (A) | 5. (C) |
| 6. (B) | 7. (A) | 8. (C) | 9. (C) | 10. (C) |
| 11. (D) | 12. (D) | 13. (C) | 14. (B) | 15. (B) |
| 16. (A) | 17. (A) | 18. (B) | 19. (D) | 20. (A) |
| 21. (D) | 22. (A) | 23. (B) | 24. (C) | 25. (B) |
| 26. (A) | 27. (A) | 28. (A) | 29. (C) | 30. (A) |
| 31. (C) | 32. (A) | 33. (D) | 34. (C) | 35. (C) |
| 36. (B) | 37. (C) | 38. (A) | 39. (A) | 40. (C) |
| 41. (C) | 42. (D) | 43. (B) | 44. (C) | 45. (C) |
| 46. (B) | 47. (A) | 48. (C) | 49. (B) | 50. (B) |
| 51. (C) | 52. (D) | 53. (B) | 54. (C) | 55. (B) |
| 56. (A) | 57. (A) | 58. (D) | 59. (D) | 60. (D) |
| 61. (D) | 62. (A) | 63. (D) | 64. (B) | 65. (C) |
| 66. (D) | 67. (D) | 68. (A) | 69. (B) | 70. (C) |
| 71. (A) | 72. (A) | 73. (A) | 74. (A) | 75. (A) |
| 76. (C) | | | | |

## Fill-up the blanks

1. Aonla, Guava
2. Mango, Banana
3. Sweet Allyssum, Petunia
4. Cynodon dactylon (Doobgrass), Stenopaherm cycondatom (Goose grass)
5. Canning, Drying, Juice/drink product etc.
6. Allyl Propyl - di - sulphide, Allyl Radical di-sulphide
7. Imbalance of hormones, deficiency of elements
8. Due to deficiency of boron and molybdenum
9. Interculture, applying organic manure
10. Summer season or **Kharif** vegetables and cold season or **Rabi** vegetables
11. Charls Darwin, year 1880.
12. IBA, Benzoic Acid (BA)
13. Free and Bound
14. Orange, Citrus, Banana, Grape
15. Gustuffson, 1936
16. In 1975
17. In 1973
18. In 1984
19. 1968
20. 1963 and 1965
21. 21 September

## True/False

1. False 2. False 3. True 4. True
5. True 6. True 7. True 8. True
9. True 10. True 11. to 15. All True
16. True

### Success Story–in Horticultural (Research)

- **Guava**—Aonla mixed RTS Drink preparation method has been standardized.
- For the production of 'A' Grade Kinno fruits–spraying (thrice) of mult K (2%) is appread a good technique.
- Tomato Variety–Kashi Vishesh, Cauliflower–Kashi Ageti, Okra–Kashi Pragati, Brinjal–Kashi Komal, Lobia–Kashi Shyamal showed good yields.
- **Potato**—Variety Kufri Chipsona–3 appeared an ideal for chips/processing. Hybrid-Kufri Himalini of Potato released.
- New Varieties released of Banana–Udhyam (ABB)
- Varieties identified–Chilli–Arka Meghana, Arka Shweta,
- New entries–evaluated–43 of Kalmegh.

### Fruits/Flowers/Spices/Crops/others—related Epithets/Proverbs

- King of Flowers—Rose
- Home of Spices—India
- King of Nuts—Almond
- Nature's Wonder—Chilli
- King of Spices—Peppers (4 types–Black/White/Green/Rose)
- Makhan Katori—Ficus Kisni
- Fountain Tree—Spethodia campeculata
- King of Pulses—Gram
- Queen of Pulses—Peas
- King of Fruit/National Fruit—Mango
- Man of the Forest—Orangutan
- False Gold—Pyrites ($FeS_3$)
- Queen of Fruits—Litchi
- True Fruit—Cashewnut
- Bowl of Apple—J & K, Himachal Pradesh
- Poor man's Apple—Guava
- Queen of Spices—Cardamom
- Queen of Flowers—Gladiolus
- Food of God—Cocoa
- Queen of Beverage—Tea
- Camel crops—Jowar
- King of Temperate Fruits—Apple
- Shyam Ber (Black Plum)—Jamun
- Butter Fruit—Avocado
- King of Arid Fruit—Ber
- Poor Man's Fruit—Ber
- Kalp Brachh/Tree of Heaven—Coconut
- Miracle Fruit—Kiwi fruit (in China)
- Green Gold—Opium
- Century Plant—Datepalm
- King of the Forest—Teak
- Adam's fig—Banana

### Facts-about Horticulture—India v/s World

- India's share in world production—10·4% in fruits & 8·5% in vegetables.
- India's I rank in Mango (39%), Banana (23%), Cheeku & Acid lime in the world.
- In horiticultural crop, the area is about 13%, presently of India's area.
- Grape productivity per unit area of India-highest in the world.
- II rank in vegetable & fruits & production of India in World; II in Onion & III in cauliflower & Potatoes.

●●●

# 6 GENETICS

## *General*

- The related incident caused due to the effect of genes or on change of lives is called genetic.
- The Science of origin of variation and pedigree of characters ( transmission in off-springs from parents) in lives or living organisms, *i.e.*, that Science of Biology, wherein, the study of genetically and variation, is called Genetics.
- The purification of (or free from) seeds from weeds, other crops seeds and the seeds of variety of same crop, is called as Genetic Purity of seed.
- Such a gene, that creates mutation in other genes, *e.g.*; **Jm gene** of maize; is called genetic mutation.
- Those small parts, wherein gene can be redivided (*e.g.*, Cistron, Muton and Recon), is called genetic micro-structure.
- The classification group *i.e.*, above the species and below the family; The first step (word) of bi-nomial-nomenclature, is called **Genus**.
- In meiosis, some difference is caused in structure; called as '**Asynapsis**'.
- The number of such micro-organisms, those have similar genetical characters, but have differences in body activity characters, is called '**Biotype**'.
- '**Protogyny**' is that "stigna matures first *i.e.*, before mature of another of any flower"
- The cross of a '$\mathbf{F_1}$' generation with such a strain that is homozygous for recessive alleles of related gene/ or genes, is called '**Test Cross**'. Or when the cross of '$\mathbf{F_1}$' hybrid is made with recessive parent. (Test cross = $F_1$ × Recessive Parent)
- If more than 2 copies of a single genome in any plant/ crop/ animal are present, that is called '**Antopoly ploidy**'.
- National Bureau of Plant Genetic Resources (NBPGR), New Delhi has started the research work at various centres *viz*. Ranchi, Bhowali, Cuttack, Shimla, Meghalaya, Arunachal Pradesh and Sikkim for increasing the productivity of crops; so that it can help to maintain the Agro-biodiversity and genetic base.
- For the collection of various germplasms and for genetic work, research work is being carried-out at IRRI (Phillipines), CMMYT (Mexico), AVRDC (Taiwan), ICARDA (Syria), USDA (USA) etc.
- For plant/bio-diversity, Mission Mode Project—NATP(National Agricultural Technology Project) was started in the country on 16 July, 1999.
- In early, '**Principles of Heridity**' was explained by Mendel (Gregor John Mendel) and as observed by hybridization on garden pea plants. He also presented '**Law of Mendel**', based on the research paper experiments in plant hybridization.
- '**Principles of Genetics**' was named as '**Mendelism**' by Mendel.
- Rhizobium bacteria are found in root nodules of legume plants *viz*. gram, pea, pigeonpea, greengram, blackgram etc. and fix the atmospheric nitrogen through symbiotic nitrogen fixation.
- '**Apogamy**'—is the development of synergid or antipodal cells in embryo without fertilization.
- Bifffin (1921) reported the resistance of stem rust in wheat-as recessive and monogenic control.
- The '**World Food Prize**'—also known as '**Nobel Prize for Food**' for the year 2000, was jointly awarded to Dr. Surinder, K. Vasal (Plant Geneticist) and Dr. Iwangelina Villegas (Bio-Chemist) of Mexco; those have

developed Miracle Maize (Corn) having excess of protein and said to be the quality protein maize (QPM); on 16 October **World Food Day,** occassion. The developed QPM germplasm through the co-ordination of Cereal Chemistry and Plant Breeding Techniques.

- '**World Food Prize**' (Nobel Prize for Food) has been awarded earlier to several Indian Scientists, namely;

  In 1987, for the first time to Indian Scientist Dr. M.S. Swaminathan, this Nobel Prize was awarded for his contribution to bring '**Green Revolution**' in India. He developed high yield varieties (HYV's) of wheat and rice.

  This '**Nobel Prize**' was given to Dr. V.G. Kurien, Ex-Director, NDDB, Anand (Gujarat) in the year 1989 for achieving '**White Revolution**' in the country *i.e.*, in milk production and/ or '**Operation Flood**'.

  The '**Nobel Prize**' was credited to Dr. Gurdev Khush and Dr. Hennary Vichail in the year 1996 for developing such varieties and genetic lines, those have doubled the rice production in last 30 years, in the world.

  It was awarded to B.R. Barwale, Mahyco Company, in the year 1998, for making private seed industry sector and this company is producing today the good varieties/ seeds (vegetables/ cereals/ oilseeds etc.)
- The word '**Genetics**' was given by Bateson in the year 1905.
- Dr. M.S. Swaminathan was honoured as a '**Millennium Prize**' by Prime Minister Atal Bihari Vajpayee in 88$^{th}$ National Science Congress on 3-7 January, 2001 held at IARI, New Delhi.
- In Rapeseed-Mustard group, three hybrids of Indian mustard (B. juncea) appeared higher yielders, namely; HB-501, HB-502 and HB-506. And 'YRN-6' mustard was identified in NRC-M(ICAR) 12th workshop (11-13 Aug. 2005).
- **TERI**-Unnat, TERI-Uttam (*Br. juncea*), Hyola-402 (*Br. napus*) varities of rapeseed-mustard showed low glucosinolate (> 30 μ mole/g free fat meal/cake) and Erucic acid (< 2%), say. Double Zero (0-0) quality, oil not harmful to human health and cake to animals also.
- Wheat Genotypes rich in nutritional quality—
  (A) **Triticum aestivum**—
  (i) Protein (≥ 13·5%)—PBW-373, HD-2833, UP-2425.
  (ii) β-Carotene (≥ 4·5 ppm)—HS-469, VL-878, MACS-6151.
  (iii) Iron (≥ 75 ppm)—HUW-533, WH-781, HD-2871.
  (iv) Zinc (≥ 50 ppm)—HI-1531, HW-4022.
  (B) **Triticum durum**—
  (i) Protein (≥ 13·0%)—PBW-295, MACS-1967.
  (ii) β-carotene (≥ 6·0 ppm)—PDW-233, WH-896.
  (iii) Iron (≥ 40 ppm)—HD-4672, HI-8627.
  (iv) Zinc (≥ 40 ppm)—PDW-291, HI-8627.

## Meaning in One Sentence

- **Auxotroph**—A mutant found in bacteria and fungi, that does not grow only in minimal medium but also grow very-well if any specific growth regulator is added.
- **Autosome**—The chromosomes, other than sex chromosomes are found in unisexual organisms both in male and female.
- **Clone**—A sexual progency of a single plant, produced only from mitotic division.
- **Dicentric Chromosome**—That chromosome, wherein two chromosomes points are present.
- **Epistasis**—Affecting the expression of any other gene by a gene.
- **Genetic Erosion**—Corresponding retardation in present genetic variability in any crop/ wild species.
- **Homoeologous Chromosome**—Similarty to some extent in gene constituent of a specific chromosome, and also pairing to some extent.
- **Heterochromatin**—A chromatin, haring less sustaining and of various genetic activities.
- **Meiosis**—A special type of cell division, wherein the reduced number of chromosomes become half.
- **Monoploid**—Such organism, wherein only one genome or chromosome-pair is found.
- **Operon**—That part of chromosome, which is formed due to mating of structural gene and controlling driving gene.

## *Multiple Choice Questions*

1. Who is said to be the '**Father of Genetics**' ?
   (A) Gene Beptist-Lemark
   (B) Iwanosky
   (C) Gregor John Mendel
   (D) Charls Darwin
2. Mendel presented the own work—
   (A) Mendelism
   (B) Law of Mendel
   (C) Heridity Law
   (D) Results/ Experiments of Pea *(Pisum sativum)*
3. Mendel told the gene—
   (A) Traits (B) Factors
   (C) Characters (D) Pures
4. Mendel differentiated the dominant and recessive characters by—
   (A) Colours (B) Symbols
   (C) Letters (D) Figures
5. Mendel's '**Principles of Genetics**' is known to which of the name—
   (A) Mendelism (B) Linkage
   (C) Cell Theory (D) Germplasm
6. How many combinations are possible in '**Dihybrid Cross**' ?
   (A) 4 (B) 8
   (C) 12 (D) 16
7. Mendel's 'Dihybrid Cross-Yy Rr' represents—
   (A) Yellow, Round (B) Green, Round
   (C) Yellow, Wrinkled (D) Green, Wrinkled
8. What was the phenotypic ratio in 'Mono-hybrid cross' of Mendel ?
   (A) 3 : 1 (B) 9 : 3 : 3 : 1
   (C) 1 : 2 : 1 (D) 1 : 1
9. If tetraploid potato has 48 chromosomes number, then how many chromosomes would be in common diploid species ?
   (A) 36 (B) 12
   (C) 24 (D) 48
10. The '**Nobel Prize for Food**' *i.e.*, '**World Food Prize**' was awarded to Dr. M.S. Swaminathan for his contribution to '**Green Revolution**' in the country through the developed HYV's of rice and wheat in the year—
    (A) 2000 (B) 1987
    (C) 1989 (D) 1998
11. National Cytology Centre is situated at which……where the work on animal cell and cell propagation bio-technology is being carried out ?
    (A) Pune (B) Kanpur
    (C) Nagpur (D) Jaipur
12. National Immunology (Immunity Science) Institute is situated at the Centre—
    (A) New Delhi (B) Lucknow
    (C) Bhopal (D) Bhuvaneshwar
13. The '**Programme on G-15 Gene**' of National Immunity Science (Immunology) Institute is being carried-out for the purpose—
    (A) For Medicinal Plants, Only
    (B) For Aromatic Plants, Only
    (C) For both Medicinal & Aromatic Plants
    (D) None of these
14. 'NBPGR—National Bureau of Plant Genetic Resources' is situated at—
    (A) Kanpur (B) Jaipur
    (C) Mumbai (D) New Delhi
15. Who is, presently (2009) the DG-Director General of ICAR and Secretary-DARE (Deptt. of Agricultural. Research & Education ) ?
    (A) Dr. Mangla Rai
    (B) Dr. M.S. Swaminathan
    (C) Dr. Punjab Singh
    (D) None of these
16. Which one of the Agricultural University in the country, its name was given on the name of first President of India, that is situated in the state—
    (A) Rajasthan (B) Bihar
    (C) Uttar Pradesh (D) Maharashtra
17. Which legume crop does not fix atmospheric nitrogen through symbiotic N-fixation ?
    (A) Frenchbean
    (B) Mungbean

(C) Clusturbean
(D) Lathyrus (Khesari)

18. The fundamental role of hair in plant is—
(A) To protect new roots from the loss due to coarse soil particles.
(B) To protect roots from soil microbes
(C) Absorption of water and minerals from soil
(D) For providing stability to plants and binding capacity of soil particles

19. Translocation of water and minerals in plant is meant through—
(A) Collenchyma (B) Xylem
(C) Phloem (D) Parenchyma

20. In plant, the translocation of food after manufacturing in leaves to other plant parts is done through—
(A) Phloem (B) Xylem
(C) Root hairs (D) None of these

21. Which plant nutrient/ element is given to a particular legume crop, if root-nodulation in the crop is poor—
(A) Molybdenum (Mo)
(B) Nitrogen (N)
(C) Phosphorus (P)
(D) Boron (Bo)

22. The word '**Genetics**' is given by—
(A) Bateson (B) Hook
(C) Corck (D) Mendel

23. RNA is synthesized in—
(A) Nucleolus (B) Protoplasm
(C) Nucleus (D) Rhibosomes

24. In double fertilization, one male gamete is fused in egg cell and the another is fused to which ?
(A) Nuclei cell (B) Polar Nuclei
(C) Antipodal cells (D) Synergids

25. Isotopes means—
(A) Same Protein Number
(B) Same Neutron Number
(C) Same Protein and Neutron Number
(D) None of these

26. The Genetic base of correlation is—
(A) Crossing over
(B) Apestatic
(C) Linkage and Poliotrophy
(D) None of these

27. Who proposed the dominance hypothesis for heterosis ?
(A) Willkins (1907) and Crick (1911)
(B) John Le Counteur (1917)
(C) Devonport (1908) and Bruce (1910)
(D) None of these

28. The beautiful colour in flowers is due to the presence of—
(A) Cytochrome (B) Cryptochrome
(C) Chlorophyll-b (D) Anthocyanin

29. In a plant cell, the place of protein synthesis is at—
(A) Mitochondria (B) Glyoxysome
(C) Ribosome (D) Mesosome

30. During 88th National Science Congress held at IARI, New Delhi on 3-7 Jan, 2001, who was honoured by '**Millennium Price**' for unique work done in the field of Agriculture ?
(A) Dr. R.S. Paroda
(B) Dr. M.S. Swaminathan
(C) Dr. A.P.J. Abdul Kalam
(D) None of these

## *Select —True and False*

1. When two dominant genes linked together, is called repulsion. (……)
2. When a dominant allele of a gene is linked with an another gene having recessive allele, then that is called repulsion phase. (……)
3. Bio-type is the group of a individual, wherein similar genotypes are present. (……)
4. When $F_1$ is crossed with recessive parent, then, it is called '**Test Cross**'. (……)
5. Shull H.G. (1914) investigated single cross hybrid heterosis. (……)
6. The contribution of Dr. M.S. Swaminathan is recognized to bring '**Green Revolution**' in Agriculture is the country. (……)
7. Dr. H. G. Khurana investigated the genetic code and synthesized the gene, for which he was awarded the '**Nobel Prize**'. (……)

8. Charles Darwin (1809-1882) presented the '**Theory of Natural Selection**'. (……)
9. France Scientist-Lemark Jene Baptist (1744-1829) presented the theory of pedegree of achieved characters. (……)
10. Genetically Engineered (G.E.) seeds are comparatively more expensive than the seeds produced by farmer. (……)
11. Growing similar types of genetically uniform plants, there is retardation in diversity of plants life. (……)
12. In any inbreeding population, heterozygotes indicate less variability than homozygotes. (……)
13. National Plant Genome Research Centre is located at JNU (Jawahar Lal Nehru University), New Delhi. (……)
14. National Brain Research Centre (NBRC) is located at New Delhi. (……)
15. DNA Finger Printing and Nedanik Centre (CDFD) Hyderabad has continued the services on DNA Finger Printing and Nedaniky since 1996. (……)

## *Fill-up the blanks*

1. One nucleotide is formed of …… and …….
2. Antibodies are produced by …… cells.
3. In plant, a non-aromatic amino acid …… is found.
4. In a insect resistant transgenic cotton plant, …… gene is obtained after transfering from Bacillus thuringiensis (Bt.).
5. In randomized block design, if there are 4 replications and 4 treatments, then error degree of freedom would be …….
6. Acquired Immune Deficiency Syndrome is caused due to …….
7. When one gene affects more than one characters, then that effect would be called …….
8. The 'Nobel Prize' for chemical nature of DNA in the year 1962 was given to …….
9. In selective '**Latin**' words, the method of nomenclature from scientific view-point of plants and animals is called …….
10. …… DNA molecule is found in bacteria.

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (C) | 2. (B) | 3. (B) | 4. (C) | 5. (A) |
| 6. (D) | 7. (A) | 8. (A) | 9. (C) | 10. (B) |
| 11. (A) | 12. (A) | 13. (C) | 14. (D) | 15. (A) |
| 16. (B) | 17. (A) | 18. (C) | 19. (B) | 20. (A) |
| 21. (A) | 22. (A) | 23. (A) | 24. (B) | 25. (A) |
| 26. (C) | 27. (C) | 28. (D) | 29. (C) | 30. (B) |

### True/False

| | | | | |
|---|---|---|---|---|
| 1. (F) | 2. (T) | 3. (T) | 4. (T) | 5. (T) |
| 6. (T) | 7. (T) | 8. (T) | 9. (T) | 10. (F) |
| 11. (F) | 12. (T) | 13. (T) | 14. (T) | 15. (T) |

### Fill-up the blanks

(1) Rhibo Sugar Phosphoric Acid & Nitrogenous base, (2) White blood, (3) Glycine, (4) Bt, (5) (9), (6) Virus, (7) Pleiotropism, (8) Watson, Crick and Wilkins, (9) Binomial Nomenclature, (10) Single.

| National Symbols |
|---|
| ● National Animal—Tiger (*Panthera tigris*) |
| ● National Fruit—Mango (*Mangifera indica*) |
| ● National Flower—Lotus ( *Nelumbo nucipera Gaertx*) |
| ● National Tree—Banyan Tree (*Ficus benghalensis*) |
| ● National Bird—Indian Peacock (*Pavo cristatus*) |

| Agriculture Realted Years-Celebrated | |
|---|---|
| 2004 | International Year of Rice (Theme-Rice is life.) |
| 2005 | International Year of Parthenium & Year of Neem |
| 2006 | International Year of Desert & Desertification/Year of Research & Development |
| 2007 | International Water Year (Theme-more crop per drop) |
| 2008 | International Year of Potato & Sanitation. |
| 2009 | Natural fibre |
| 2008-09 | Food Security & Quality Year (by Mini. of Food Processing Industries) |
| 2010 | Year of Tigers, International Biodiversity year. |
| 2011 | (i) Forests & (ii) Chemistry—International year |
| 2012 | Horticulture Year in India—International Co-operative year. |
| 2014 | Horse Year |
| 2016 | Pulse Year-2016 declared by **IPTIC** (International Pulses Trade and Industry Confederation) Dubai. |

●●●

# 7 PLANT BREEDING

## *General*

- India is the first country in the world to develop varieties of hybrid cotton.
- "**Jai Vigyan Rashtriya Vigyan** and **Praudh-yogiki Mission-1999**" was started on protection (Plant Genetic Resources) of Agro-Bio-diversity.
- '**INDU**'- A high yielding variety of Yam (**Dioscorea alata**) was released by Regional Agricultural Research Station, Kumarakom (Kerala), and this was the clonal selection of the material sent by NBPGR. Its production efficiency is around 47 ton/ ha and is suitable for intercropping in coconut orchard. This also gives 25% higher yield than variety 'Shree-rupa'.
- **Wheat—**variety 'Shreshtha' (HD-2687) & PBW-550 for irrigated and timely sowing ; **'UP-2425'**-irrigated and late sown; **Maize**—Vivek Hybrid-4 (Early Variety); **Baby Corn**—Him. 129, VL-42, Pusa Hybrid-1, Pusa Hybrid-2 and Prakash; **Barley—**DWR-27, DWR-28, UBE-441, UBE-446, UBE-477 and UBE-990 (Two-row barley) and K-633, UBE-435 (6-row barley), have been identified as good varieties of these crops.
- **Sorghum—**Early Hybrid CSH-17 for *Kharif*; **Pearlmillet**-Pusa-415, Pusa Hybrid 605 are the good varieties for yield.
- The mating or hybridization between two such individuals, of the pedigree of a parent, is called '**Inbreeding**'.
- Smaller/ or Minor millets *e.g.* Kodo, Mondua (Ragi), Sawa, Kakun (Kangni, Kamuni), Cheena etc. are the rich source of protein and lysine.
- Clonal propagation of heterozygous plants is promoted by tissue culture of juvenile cells of apical meristem.
- Removing or replacing immature anthers from any bisexual flower, is called emasculation.
- The progency obtained from hybridization in individuals or strains of two or more different genotypes, is called cross/ or hybrid.
- Generally, corresponding breeding between two varieties./ or breeds of the same species, is called '**Cross Breed**'.
- **Cross pollinated crops—**Such individual of plants grown for production and its each plant having same gene collection or pair source produces new genotypes generation to generation, *e.g.* **toria**,brown mustard, sunflower etc.
- Cross pollination is that process, wherein the transfer of pollengrains of a flower to the stigma of any another flower, is happened.
- **Crossing over—**During meiosis, exchange of homologous segments between homologous chromosomes segments, which happens in pachytene stage.
- '**Roguing**' is that process, wherein the unwanted plants are removed from seed production field/plots, *i.e.*, pull-out/or destroy the unwanted or rogue plants before flowering or seed setting from the field.
- **Rogue plants—**In any crop, the undesirable/ or off type/or unwanted plants either of weeds or other crop (s) or another variety of same crop, are called rogue plants *e.g.* in wheat (UP 2338) field- chenopodium weed or plants of another wheat variety like-HD 2329 or gram plants in wheat (UP 2338).
- **Isolation—**Separating two plants, strains or populations, by avoiding mating or hybridization in them generally possible by distance or border rows.
- **Isolation distance—**The distance to be maintained between seed crop and contaminated crop in seed certification/ multiplication, is called '**Isolation distance**'.
- **Registered Seed—**Such seeds, wherein satisfactory genetic identity and purity be

maintained, those seeds must be certified through seed certification agency (say; progeny of foundation seed).

- **Certified Seed**—Certified seed is the progency of breeder, foundation or registered seed, produced by States Seed Farms or by certified farmers, which is handled to maintain satisfactory genetic purity and acceptable to certifying agency.
- **Out Breeding**—The mating of unrelated organisms.
- **Out Cross**—The progenies obtained by mating in natural form of two different genotypes or strains./Or the cross pollination of any plant to any other plants (generally in natural form).
- **Breeder Seed (Nucleus seed)**—The seed, which is the resultant of hybridization, selection and mutation, produced by breeder and also have desired all genetical characters (100% genetic purity), is called '**Breeder/ or Nucleus seed**', and directly controlled by organization/ sponsoring Institute or individual.
- **Tag Colour of Seeds**—(i) Breed seeds—Yellow tag, (ii) Foundation seeds—White tag, and (iii) Certified seeds—Blue tag.
- **Breeding**—According to economic use, the Art and Science of improving the genetical structure of plants is called breeding, which is both in plants and animals.
- **Pure Seed**—The seeds of any species stated by senders/ or found to pre-dominate in the purity test.
- **Pure Live Seed**—Percentage of pure germinating seed, determined by multiplying the pure seed percentage by its own germination percentage and dividing the product by 100; say;

  % pure live seed

  $$= \frac{\text{Pure seed percentage} \times \text{Germination percentage}}{100}$$

- **Mutation**—Sudden change in gene is called '**Mutation**'. /or sudden appearance of new special characters in any specified live (man/ plants) as a result of sudden/ heritable change in gene or chromosome.
- **Mutation Breeding**—Application of variations developed through mutagenesis in crop improvement.
- **Mutant**—Any chemical or physical product/ matter, which is responsible for mutation in gene.
- **Mutagen**—Any chemical or physical agent, which produces mutation.
- **Mutagenesis**—Developing mutation through/ or with the help of any mutagen.

## Meaning in One Sentence

- **Homogenous (Plants)**—In which population, presence of individuals of a single type or genotype.
- **Heterozygous (Plants)**—In which individual, two different alleles are present in any gene.
- **Plant Breeding**—That science of such changes in genotype of plants, so that those may be more useful for mankind./ or Plant Breeding is the branch of a Science, an Art and an Agricultural activities. (Vavilov).
- **Phenocopy**—Such modification that is similar to phenotype of any known mutation-gene(environmental activated, not by pedigree).
- **Phenotype**—An external shape/ form/ or appearing form of any individual for one or several characters.
- **Phenotypic ratio**—The ratio of different phenotypics/ phenotypes in a specific progency.
- **Heridity**—The transmission of physical and other characteristics from parents to off-spring.
- **Heritability**—That constituent of phenotypic variance, which is produced due to genotype.
- **Heriditary**—Transmittable from parents to off-springs.
- **Variation**—The present variation in phenotypes of different individuals of a single species.
- **Cleistogamy**—When pollination and fertilization completed in closed floral bud./ Or such flowers, those do not open ever, having bisexual flowers and self-pollinated.
- **Allele**—The different forms of a gene are allele of each other, say; Alleles are situated in homologous chromosomes as a locus.
- **Isolation**—Separating two plants, strains of populations in such a way, wherein mating/or hybridization may not possible in them,

generally, possible by distance or border rows.

- **Clone—**Asexual progeny of a single plant; produced from mitotic division/ or A group of plants produced from vegetative propagation of a (same) plant.
- *n*-Gametic chromosome number of a species.

2*n*-Somatic chromosome number of a species.

LD50-the amount of any mutagen or any other factor, 50% dead occured on account of treated amongst the plants or animals.

- **Bio-type—**The presence of a sub-group in any species/or number of such micro-organisms; those have similar genetical characters, but different in body-practical characters./Or such strains of any pathogen species, which are different in efficiency of infection of different varieties of the same host species.

During 2007-08, under Indian Seed programme by the ICAR/SAVs/NSC–1 lac quintal breeder seeds and 9·69 lac quintals foundation seeds were produced & 190 lac quintals certified/quality seeds were distributed.

## *Multiple Choice Questions*

1. In India, '**Green Revolution**' was related to which high yieldings—
   (A) Wheat & Mustard
   (B) Rice & Barley
   (C) Rice & Wheat
   (D) Maize & Sorghum
2. To whom (Scientist), 'The Nobel Prize' for agricultural production (food) has been awarded so far ?
   (A) Dr. M. S. Swaminathan
   (B) Dr. N. E. Borlaug
   (C) Dr. S. Luria
   (D) None of these
3. The example of protandrous species is—
   (A) Carrot (B) Avocado
   (C) Walnut (D) None of these
4. Pseudo fertility is caused due to delay in season in—
   (A) Tea (B) Tapioca
   (C) Tobacco (D) Tomato
5. In which of the following, Thomas Andrew Knight reported the resistance against it for the first time in varieties of wheat—
   (A) Rust (B) Wilt
   (C) Smut (D) Bunt
6. How many pollengrains approximately for each grain are developed in tassel of maize ?
   (A) 25,000 (B) 10,000
   (C) 40,000 (D) None of these
7. Pearlmillet *(Bajra)* is a crop—
   (A) Self-Pollinated (B) Auto-crossed
   (C) Cross-Pollinated (D) Out-crossed
8. Gladiolous is produced through—
   (A) True seed (B) Bulbs
   (C) Stem cutting (D) Roots
9. In which conditions, the seeds can be preserved safely—
   (A) Cool & Dry (B) Cool & Wet
   (C) Hot & Dry (D) Hot & Wet
10. Inflorescence of sugarcane is called—
    (A) Arrow (B) Tillering
    (C) Silking (D) Tasseling
11. "Seed production/ propagation and distribution is the method, to which seed users believe that they will get price upto the end by growing the good quality variety, seed is pure and of good quality and also free from expected diseases"—this statement agree with the thoughts of—
    (A) Dr. A. A. Johnson
    (B) Mendel
    (C) Hedge Dammer & Smith (1955)
    (D) None of these
12. …… contributes in formation of true seed.
    (A) Ovule
    (B) Calyx
    (C) Vegetative nucleus
    (D) Nucleus
13. The development (formation) of seed is on—
    (A) Mating of male gamete in egg cell
    (B) Mating of male gamete with accessory cell
    (C) Mating of male gamete with antipodal cell
    (D) Mating of male gamete with polar nuclei
14. Plant absorbs water from the soil—
    (A) Hygroscopic water
    (B) Capillary water
    (C) Gravitational water
    (D) None of these

15. Kreb's Cycle is also called—
    (A) TCA Cycle
    (B) Organic Cycle
    (C) Both TCA Cycle & Organic Cycle
    (D) None of these

16. Match the following—

| **Crop** | **Origin place** |
|---|---|
| (A) Tobacco | (i) China |
| (B) Wheat | (ii) Tropical America |
| (C) Potato | (iii) Asia minor |
| (D) Soybean | (iv) South America |

17. Match the following—

**Crop**
(A) Oat
(B) Barley
(C) Maize (Corn)
(D) Tobacco (Nicotiana tabacum)

**Chromosomes Number**
(i) 20 (ii) 7
(iii) 21 (iv) 24

18. Match the following—

| **Gene** | **Crop** |
|---|---|
| (A) Norin Gene | (i) Wheat |
| (B) Opaque-2 | (ii) Maize |
| (C) Dee Gee | (iii) Rice |
| (D) Tifton | (iv) Bajra |

19. Match the following—

**Crop**
(A) Potato (B) Sunflower
(C) Cotton (D) Soybean

**Commercial Hybrids Release year**
(i) 1980 (ii) 1972
(iii) 1975 (iv) 1980

20. Match the following—

**Crop**
(A) Cabbage
(B) Broccoli (Brassica oleracea var. gemnifera)
(C) Carrot
(D) Cauliflower

**First Commercial Hybrid's Release Year**
(i) 1961 (ii) 1964
(iii) 1966 (iv) 1954

21. Match the folloswing—

**Crop**
(A) Brinjal (Egg Plant)
(B) Tomato
(C) Onion
(D) Winter Squash

**First Commercial Hybrid's Developed Year**
(i) 1943 (ii) 1939
(iii) 1948 (iv) 1950

22. Match the following—

**Plant Habit**
(A) Short Day Plant
(B) Long Day Plant
(C) Intermediate Plant
(D) Day Neutral Plant

**Plant Name**
(A) Phaseolus vulgare (Kidney bean)
(B) Beta vulgaris (Sugar beet)
(C) Glycine max (Soybean)
(D) Media ilegans (Tarweed)

23. Match the following—

**Section A**
(A) DNA (B) Avery
(C) Stahl (D) TMV

**Section B**
(i) Plant Virus
(ii) Semi-conservative
(iii) Poly-nucleotyde
(iv) Transforming Principle

24. Match the following—

**Section A**
(A) Vigna mungo
(B) Vigna unquiculata
(C) Cajanus cajan
(D) Cicer arietinum

**Section B**
(i) Blackgram
(ii) Horsegram
(iii) Redgram
(iv) Bengalgram

25. Match the following—

**Plant**
(A) Canaf (B) Stocassia
(C) Naranjeela (D) Peach Palm

**Uses**
(i) For providing pulp
(ii) Extracting oil from seeds
(iii) For making salad from fruits
(iv) Best source of Fruit-Carbohydrates, Protein, Lipids, Vitamines and minerals

## *Select —True and False*

1. The ratio of grain to total dry matter production is called **'Harvest Index'** (HI) (……)
2. Plant Breeding is the branch of a science, an-Art and Agricultural operations (Vivilov) (……)
3. In the year-1840 in Ireland, famine came in late blight of potato. (……)
4. In U.S.A., the famine happend due to leaf blight in maize in the year 1970. (……)
5. Charls Darwin (1809-1882) gave the **'Theory of Natural Selection'** of development. (……)
6. Robert Hook (1665) made a research of cell. (……)
7. Robert Brown (1831) originated the nucleus. (……)
8. Waldeyer (1888) reported the world '**chromosome**', for the first time. (……)
9. H. J. Muller (1935) gave the knowledge of '**Gene**' and also reported the importance of controlling it. Also, he was awarded the '**Nobel Prize**' for his contribution to artificial mutation in sandrosophila fly through X-rays (……)
10. Gregor John Mendel (1865) reported the '**Law of Inheritance**' and later on in 1900, it was recognized. (……)
11. Greev (1682) told for the first time the anthers as male organ in flower of plants. (……)
12. Morgan, T. H. (1910) presented the 'Linkage theory' and also established the '**Chromosomism of pedigree**'. (……)
13. Castor's seed is dicotyledonous and endospermic. (……)
14. In '**Meiosis**' division, crossing over is in diplotin phase. (……)
15. In cell, genetic unit is 'gene'/ genes. (……)

## *Fill-up the blanks*

1. '**Back cross**' can also be used for useful purpose in …… breeding programme.
2. Sunflower, a cross pollinated species, which is very well …… for in breeding programme.
3. Male sterile condition is ……
4. …… is a device, wherein seeds of hybrids are produced in enough quantity.
5. The development of embryo from egg cell without fertilization is called ……
6. '**Rhizobia**' can also act …… with cells of non-legume plants (*e.g.* wheat, tobacco, rice etc.)
7. Fill up the blank in following A. V. T.; if there are 4 families (4F), 3 location (3-L) and 4 replication (4-R), then—

| *Source of Variation* | *df* |
|---|---|
| R | 3 |
| F | 3 |
| L | 2 |
| FL | 6 |
| Error | … |

8. If $F_1$ off-spring is crossed simultaneously with both parents, then that is called ……
9. The '**Theory of Pure Line Selection**' was proposed by …… scientist.
10. That plant, which produces seeds, but there are lackings of flowers, is kept in …… group.

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (C) | 2. (B) | 3. (A) | 4. (C) | 5. (A) |
| 6. (A) | 7. (C) | 8. (B) | 9. (A) | 10. (A) |
| 11. (A) | 12. (A) | 13. (A) | 14. (B) | 15. (A) |

| | | | |
|---|---|---|---|
| 16. (A)-(ii) | (B)-(iii) | (C)-(iv) | (D)-(i) |
| 17. (A)-(iii) | (B)-(ii) | (C)-(i) | (D)-(iv) |
| 18. (A)-(i) | (B)-(ii) | (C)-(iii) | (D)-(iv) |
| 19. (A)-(i) | (B)-(ii) | (C)-(iii) | (D)-(iv) |
| 20. (A)-(iv) | (B)-(i) | (C)-(ii) | (D)-(iii) |
| 21. (A)-(ii) | (B)-(i) | (C)-(iii) | (D)-(iv) |
| 22. (A)-(iii) | (B)-(ii) | (C)-(iv) | (D)-(i) |
| 23. (A)-(iii) | (B)-(iv) | (C)-(ii) | (D)-(i) |
| 24. (A)-(i) | (B)-(ii) | (C)-(iii) | (D)-(iv) |
| 25. (A)-(i) | (B)-(ii) | (C)-(iii) | (D)-(iv) |

### True/False

From 1 to 15 — All are True (T)

### Fill-up the blanks

| | |
|---|---|
| 1. Pedigree | 2. Tolerant |
| 3. Recessive | 4. Male sterility |
| 5. Parthenogenesis | 6. Symbiotically |
| 7. 33 | 8. Back cross |
| 9. W. L. Johnson | 10. Gymnosperm |

●●●

# 8 AGRO-BIO-TECHNOLOGY & GENETIC ENGINEERING

## *General*

- The Head Quarter (H.Q.) of ICGEB—International Centre for Genetic Engineering & Bio-Technology is located at Italy ; with its Sub-Head Quarter at New Delhi.
- **Short Name (Abbreviation)**—
  HIV : Human Immuno-deficiency Virus
  HBV : Hepatitis B-virus
  IPM : Integrated Pest Management
  NPV : Nuclear Polyhydrosis Virus
  HPT : Hygro-mycin Phospho Transferase
  GFP : Green-House (Green) Floroscence Protein
  GST : Glutethian S. Transferase
  GT : Glanjma Thrombosthemia
  CIMAP : Central Institute of Medicinal & Aromatic Plants, Lucknow
  TBGRI : Tropical Botanical Garden & Research Institute, Thiruvananthapuram, Kerala.
  RSI : System of Rice Intensification.
  HFT : Horizontal Flushing Technique.
- **Virology**—That branch of Science, which deals with study of viruses. The research work is being carried-out at the **ICGEB**, New Delhi, on haptisis & Aids.
- For the specific area of research work of Agro-Bio-Technology is at Assam Agriculture University Jorhat and Kerala Agric. University Thrissur (old name Trichur), Kerala.
- The work on Aqua-Agriculture is being carried-out at Central (Fresh water) Aqua-Agriculture Institute, Bhuvaneshwar (Orissa).
- The research work on Environment and Agro-Bio-Technology is being carried-out at B.H.U. Varanasi (U.P.) and on Environment Bio-Technology at National Environmental Engineering Research Institute, Nagpur (Maharashtra).
- Lal Bahadur Shastri Bio-Technology Centre is situated at IARI, New Delhi.
- TNAU (Tamil Nadu Agric. University) Coimbatore is on front line (pioneer) in the field of Plant Molecular Biology.
- At PAU (Punjab Agriculture University), Ludhiana, $F_3$ progenes have been identified for Karnal bunt, Nematode, Strip diseases in wheat, so that resistant genes can be prepared.
- The species of Blue Green Algae (BGA) in rice crop (field) are found; Nostoc, Cylindospurmum, Wastiya, Lopsis, Hepelociyon etc. Nearly 120 species of algae have been identified and their genes are; Ocilatoria, Lingbia, Aphnothecy etc., that fixes nitrogen (N) through fixation. In rice, application of algae increased the rice yield by 25-32%, as reported by several experimental evidences.
- **Bio-Pesticides**—For Controlling the insect-pests in crops, several bio-pesticides have been developed. Their use in brinjal, Okra, tomato, pigeonpea, mustard etc. is quite obvious for pest-control, *e.g.* the bio-products of Neem **(Azadirachta indica)**, Pongamia, Jetropha, Ipomea, **Tulsi** etc.
- In Medicinal Plants; Mint **(Mentha arvensis)**, Asthwagandha, Isabgol **(Plantago ovata)**, Opium Poppy **(Papaver somniferum)**, Belladona **(Atropa belladonna)**, **Senna (Cassia angustifolia)**, Sarpgandha (Rauwolfia–**Rauwolfia serpentina)**, etc. are the major medicinal plants.
- In silk production, silk moths are reared on mulberry plants/or on plant leaves, which is called **'Moriculture'**.
- For mushroom cultivation; Dr. M.S. Swaminathan Research Foundation, **Chennai** (T.N.), Community Agro-Bio-Diversity Centre, Puthuvaya (Kerala), IIT-New Delhi; and National Mushroom Research & Training Centre, Solan (H.P.) are some of the research Centres.

- National Medicinal & Aromatic Plants Research Centre is situated at Anand (Gujarat).
- National Plant Bio-Technology Research Centre, at IARI New Delhi; and National Aqua-Technology Research Centre, Bhuvaneshwar (Orissa) are working in their respective research fields.
- Bio-Control has been found successful in Cotton, Groundnut, Okra (Lady's finger), pulses and other vegetables due to spraying of NPV of **Helicoverpa armigera** and **Pseudoptera litura.**
- In IPM (Integrated Pest Management), **Trichoderma cloneese** (Parasite), **Crysoperla carnia)** (Predator) and NPV have given good performance in pigeonpea and cotton.
- **Remote Sensing**—The utility of **'remote sensing'** is increasing day-by-day in agriculture; wherein ready for fast information can be collected with the help of information collection resources or means (Sensing, Plateform, Aeroplane system etc.). In this fast collection system, mapping, air and water pollution survey related work, aerial maps though aeroplanes/satellite is possible.
- In **'Bio-Technology'**, the group of techniques of genetic manipulation of living organisms at cellular and molecular level is included.
- From 1990's decade, private sector (NGO's) has started to expense on 'Agro-Bio-Technology' research work and going forward through R & D (Research & Demonstration) up to the fields / or users say; farmers.
- In whole world, since 1999, the transgenic plants are being raised on around 28 million hectare area/land; and assuming that in next 5 years, those would be doubled.
- In the field of **'Plant Genetic Engineering'**, the first success has been obtained by producing such types of seeds/or plants on which the pests would not attack and the use of pesticides can be reduced; and the genes (Bt) separated from bacterium **Bacillus thuringensis** have the capacity of synthesizing of insecticidal protein. Now, Bt-cotton, maize and other crops are being grown from commercial points of view; that require very less pesticides. Thus, the pressure/load of chemicals in atmosphere, which is increasing, will reduce.
- Through **'Agro-Bio-Technology'**, the help is possible in breaking yield barriers, pesticides reductions, quality improvement, cleaner environments etc.
- In U.S.A. (United States of America), there was a estimation to reduce the quantity of pesticides upto/or more than 90,00,000 kg through the Bt-Cotton; and so also in 3 years (1996-98), a success has been obtained in reducing the pesticides use upto 3·8 million litre.
- On Central Cotton Research Institute (CCRI) Nagpur (Maha.), the research work is being carried-out for the development of new varieties through Bt-genes in Cotton; so as to avoid pests/diseases in Cotton.
- In Cuba, Chile, Argentina and Brazil, through the use of agro-bacterium—a Gene Shuttle, 16 transgenic lines have been prepared; where in, each has two gene pairs; those are resistant against several virus, fungal and bacterial diseases.
- In Brazil and Chile, there has been developed the resistanceness in transgenic lines against severe pathogen **(Erwinia Bacterium)** of potato; that has the properties of anti-microbial proteins like—Lysozymes and Attacin.
- With the joints afforts of International Laboratory for Tropical Agriculture & Biotechnology St. Louis; Centre for International Tropical Agriculture (CIAT) Cali, Columbia and Cassava Bio-Technology Net work; the Cassava plants have been made resistant against African Cassava Mosaic Virus, through which, the yield of Cassava has increased 10 times.
- There has a good research work in **'biotechnology'** on banana to combat against the dangerous fungal disease—'Mycosphaerella Fiziensis' at Catholic University, Leaven, Belgium.
- For improving the quality of food-products, there is a need of **'Bio-technology'** research, so as to solve the existing malnutrition problem, present (especially) in India. For balance nutrition to human, there is a need of macronutrients—carbohydrates, lipids, protein etc. and micro-nutrients (Organic or Inorganic compounds, 17 minerals and 13 Vitamins).
- In **'Genetic Engineering'**, with the help of **'Antisence Technology'**, modified oil (Fatty acidase composition) can be made available

to human health. From the year 1995, in the composition of seed, of (for the first time) transgenic crop-Rape-seed/mustard, lauric acid has been changed, that has helped to manufacture in Novel seed oils/or in seeds proteinous varieties.

- Surely, the new directions would be made available through the change in quantity and quality of protein in the field of **'Genetic Engineering'**, that would be the boon to the country like India, where most people are vegetarian. At IARI, New Delhi, the research work on gram, lathyrus and mustard is being carried-out. Some of the lathyrus lines have been developed having low in '**neurotoxin**' level; that indicates the power of **'Bio-technology'**, so that the crop quality can be improved, the human diseases like-paralysis and **'goitre'** diseases are appeared; a major problem in Bihar and Madhya Pradesh.
- In United States of America, through **'Genetic Engineering'**, by increasing **'Beta carotene'** element in oil of rape-seed-mustard, Vit-'A' has also been increased. **'Colour Blindness'** disease in human-being is appeared due to the deficiency of 'Vit-A' and through this research, it is possible to overcome this problem.
- The work of cleaner Environment is possible through Genetically Engineered Plants; this would improve the environmental pollution, by reducing the load of pesticides and also will reduce toxic elements, besides land improvement and cost effective technology.

## *Multiple Choice Questions*

1. **'ICGEB'** (International Centre for Genetic Engineering and Bio-Technology) is situated at—
   (A) New Delhi (B) Mumbai
   (C) Chennai (D) None of these
2. The Head Quarter of **'ICGEB'** is at—
   (A) Italy (B) Tokyo
   (C) Singapore (D) None of these
3. The **World Food Day'** is celebrated every year on the date—
   (A) 16 October (B) 16 November
   (C) 16 December (D) None of these
4. **'The World Food Prize'** (*i.e.,* 'Nobel Prize for Food') was awarded to whom for the Year 2000—
   (A) Dr. Surinder K. Vasal and Dr. Evangelina (Jointly)
   (B) Dr. M.S. Swaminathan
   (C) Dr. Gurdev Khush and Dr. Henary Vichel (Jointly)
   (D) Dr. V. Kurean
5. Bio-Technology Information System (BTIS) works on which of the theme of Bio-Technology ?
   (A) For Genetic Resources (Nucleic Acid Protein Sequenses Germ-plasm data Bank etc.) in the form of hard data, only
   (B) For reference index of research publications through on-line assess media upto soft Information Network or CD-ROM, only
   (C) For Directories of management related information (Research and Development Project and Resources), only
   (D) On all above works jointly.
6. At National level, facilities of BGAC—Blue Green Algae Collection are available at—
   (A) IARI, New Delhi
   (B) GBPUAT, Pantnagar (Uttaranchal)
   (C) Lucknow University, Lucknow
   (D) Rajasthan University, Jaipur
7. Filaria parasite and antibodies related research station **'MGIMS'** is situated at—
   (A) Sewagram, Wardha (Maha.)
   (B) Kanpur
   (C) Gwalior
   (D) None of these
8. National Bureau of Plant Genetic Resources (NBPGR) is situated at—
   (A) IARI, New Delhi (B) Kanpur
   (C) Chennai (D) Kolkata
9. At Modipuram, Meerut of Western U.P., one Agriculture University (SAU—State Agricul-

ture University) has been opened; its name has been kept on the name of which great-man—
(A) Lal Vahadur Shastri
(B) Sardar Vallabh Bhai Patel
(C) Chaudhary Charan Singh
(D) Rajeev Gandhi

10. Photo-Phosphorylation is meant for—
(A) Production of ATP
(B) Production of NADP
(C) Oxidation of $CO_2 \rightarrow$ in carbohydrates
(D) Production of energy

11. Rhizobium innoculation-an active and efficient strain having optimum dose would only be effective, when supply in suitable....
(A) EC (B) N
(C) Zn (D) pH

12. Chlorosis in plants occurs under deficiency of....
(A) Manganese and Sulphur
(B) Boron and Phosphorus
(C) Calcium and Oxygen
(D) Nitrogen and Magnecium

13. Fruit formation is suppressed, if deficiency is there, of—
(A) Calcium (B) Sulphur
(C) Boron (D) Magnesium

14. The Oxygen in photosynthesis is released due to—
(A) Break down of $CO_2$
(B) Break down of Chlorophyll
(C) Through reduction of $CO_2$
(D) Through oxidation of $H_2O$

15. Photosynthesis in fungi is not occured due to the deficiency of—
(A) Chlorophyll (B) Phosphorus
(C) Nitrogen (D) Potassium

16. Which hormone controls flowering ?
(A) Kinins (B) Gibberellins
(C) Florigen (D) IAA

17. In plant cells, the chemical substance found in abundence in middle lamella, is—
(A) Lignin (B) Pectin
(C) Cutin (D) Suberine

18. Lecithin is a—
(A) Polar lipid (B) Prolin
(C) Natural lipin (D) None of these

19. Bio-Technology Research and Promotion Committee, at the National level, was constituted on—
(A) April 1995 (B) April 1997
(C) April 1998 (D) None of these

20. For the control of plant-insects, bio-control agent **'Trichograma'** is developed from which place and also its production technologies in being patented by—
(A) IARI, New Delhi
(B) G.B. Pant University
(C) Delhi University
(D) Tamil Nadu Agriculture University

## *Select —True and False*

1. **'NBPGR'** (National Bureau of Plant Genetic Resources), New Delhi has the facilities of more than 2000 germplasms of Agri-Horticultural crops. (...)

2. For the surveying of coastal area/region in respect of available cyno-bacterial properties (Wealth) in the country, national facility is given Bharatidasan University, Trichi (Kerala). (...)

3. In a special function, on 10th September, 1997, first Golden Jubilee Bio-Technology Scholarship Prizes were awarded to Dr. Sayed E. Husnain (NII, New Delhi) and Prof. Jayant B. Udgaonkar (TIFR, Bangalore). (...)

4. EPA (Environment Protection Act) was constituted in the year 1986. (...)

5. Bio-Safety Committee (BSC) was constituted on dated 5th December, 1989 under Evnironmental Protection Act Institutional No. 1037 (E). (...)

6. Bio-Technology Department (DBT) of India has applied for 22 patent (applications), along-with USA and other countries, of which, India has obtained one patent in the year 1997-98. (...)

7. A **'Bio-Village'** in Gujarat near Porbander has been established in a Village–**'Mochha'**, so that economic development may be done

by using efficient technologies through integrated methods.

8. Gandhi-Gram Gramin Sansthan, Gandhi-Gram (Tamil Nadu) has made a significant work for the development of mulberry and other crops on **'Vermi-compost'**. (…)
9. At Central Tuber-Crops Research Institute (CTCRI), Thiruvananthapuram (Kerala), the research work on National Gene Bank Aromatic and Medicinal Plants is being carried-out. (…)
10. **'BGA'**—Blue Green Algae and Azolla come in the categories of **'Bio-fertilizers'**. (…)

## *Fill-up the blanks*

1. The cell membrane contains more quantity of … (lipid).
2. For preparing the **DNA** Model, Watson and Crick believed more on the results of ….
3. In DNA replication, helix is without wound, due to ….
4. Complete the following abbreviation—
   (i) B.T.I.C. ….  (ii) B. T. (Bt.) …
   (iii) B.M.N.P.V. …  (iv) U.F.P. …
   (v) B.T.I.S.Net. …  (vi) D.B.T. …
   (vii) H.E.V. …  (viii) V.A.M. …
   (ix) W.W.W. …  (x) N.I.V. …
5. Fill-up the Head Quarter (H.Q.) of the following Institutes—
   (i) Indian Agricultural Research Institute (I.A.R.I.) …
   (ii) Bhabha Atomic Research Centre, …
   (iii) Sanjay Gandhi (P.G.) Medical Science Institute …
   (iv) Indian Science Institute …
   (v) National Biological Science (Bio-Science) Institute …
   (vi) Indian Spices Research Institute …
   (vii) Central Silk-moth Research & Training Institute, …
   (viii) Tropical Botanical Garden and Research Centre …
   (ix) Cancer Research Institute …
   (x) National Antibodies Science Institute …

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (A) | 2. (A) | 3. (A) | 4. (A) | 5. (D) |
| 6. (A) | 7. (A) | 8. (A) | 9. (B) | 10. (A) |
| 11. (D) | 12. (D) | 13. (D) | 14. (D) | 15. (A) |
| 16. (C) | 17. (B) | 18. (A) | 19. (B) | 20. (A) |

### True / False

From 1 to 10 — All True

### Fill-up the blanks

1. Phospholipids  2. Wilkins
3. Topisomerase
4. (i) Bio-Technology Information Centre
   (ii) Bacillus-thuringiensis (Bt)
   (iii) Bombax Mori Nuclic Polyhedrosis Virus
   (iv) Ultra Fato Protein
   (v) Bio-Technology Information System Network
   (vi) Bio-Technology Department (Deptt. of Bio-Technology)
   (vii) Hepatitis-E-Virus
   (viii) Vassicular Arbuscular Mycortiza (VAM)
   (ix) World Wide Wave
   (x) National Institute on Virology
5. (i) New Delhi
   (ii) Trombay, Mumbai
   (iii) Lucknow
   (iv) Bangalore
   (v) Bangalore
   (vi) Calicut
   (vii) Mysore
   (viii) Palod, Thiruvananthapuram, Kerala
   (ix) Parel, Mumbai
   (x) New Delhi

**Memorable Points in Agriculture**

- Ist—President of ICAR-Sir Mohammad Habibullah (in 1929)
- Ist—Vice-President of ICAR–Dr. B.P. Pal (on 5th Amy, 1976)
- ICAR—set-up on 16 July, 1929 (Re-organized twice in 1965 & 1973)
- DARE—established in Ministry of Agriculture (GOI) in December, 1973
- IARI (Imperial Agril. Research Institute–old name)-as a unit of **ICAR**—est. in 1905 at Pusa (Samastipur) Bihar "Naulakha farm)—16000 acre farm and transferred due to earthquake building damaged to New Delhi in 1936 & Started—New Pusa (IARI) (Indian Agricultural Research Institute-new name)

●●●

# 9 PLANT PATHOLOGY

## *General*

- The order of agro-chemicals in seed treatment of crops is kept as : **'FIR'**—**F**ungicide (first), **I**nsecticide (in middle) and **R** hizobium-culture (in last); This is called the principles of **FIR** in seed treatment. Further, it has been supplemented with **miticide**, then, it is quoted as; FIMR—Fungicide, Insecticide, Miticide & **Rhizobium.** (Miticide/Rodenticide chemicals) can also be used as seed treatment.
- ICAR has made an agreement with M/s Cadila Pharmacuticles Ltd. for the production of Kalisena SD-for seed treatment and Kalisena SD Bio-formulations-for 6 dangerous soil-borne pathogens having wide host range; so that those may be sold in Africa, America and Asia.
- Scientist-Meyer in 1886, searched-out through his researches **'mosaic'** disease in tobacco, caused by virus, for the first time and also through this virus, mosaic disease is spread-out in tomato, mungbean, soybean, potato, papaya, chilli etc.
- **'Kinetin-6 Furfurl-Amino-Lurine'** is a good and known cytokinin.
- In Ireland, in the year 1846, the late blight disease of potato caused a **'Famine'** and in Sri Lanka in 1867, rust disease in coffee also created a serious threat.
- In the year 1943, **'Bengal Famine'**–came by **brown leaf spot** disease in rice, resulted into the crop damaged completely. Similarly, in 1918-19 in delta of Godavari and Krishna rivers, the rice crop was also damaged due to this disease, whereas in Uttar Pradesh, in 1938-39, famine came in sugarcane due to **'red rot'** disease.
- Scientist E.J. Butler is called the **'Father of Modern Plant Pathology'** in India, who widely studied the Indian fungus at IARI (Imperial-Pusa, Bihar) before 1910 and his written book 'Fungi and Disease in Plants' is most popular.
- Amongst the Plant Pathologists, Dr. R.K. Tandon (Allahabad University), Dr. T.A. Sadashivan (Madras University), Dr. K.C. Mehta (Dr. Karam Chand Mehta—Spotless Man, Agra College, Agra), G.S. Kulkarni and V.V. Mundkur, are all recognised.
- Biotrops are such bios(lives), and always get their (own) food from the living tissues of host in nature, on which they complete their life cycle.
- **'Neucrotrophos'**—The pathogen, kills immediately to any organic/or entire plant of own host plant after attack, is called **'Neucrotrophos'**.
- The genome of most plant-viruses (plant disease creating/spreading virus) are made-up of Ribose-Nucleic Acid (RNA) molecule (or molecules), but in some virus groups, it is made-up of De-Oxy-Ribose Nucleic Acid (DNA) *e.g.* in Gobhi Mosaic Virus.
- The common mosaic virus creates virus disease in **Rajmah** (Rajmesh). This virus is spread (transmission) through aphid species–**Aphis craccivora**.
- The mosaic disease of peas and lentil is cause by a virus-a group of **'potivirus'**. The species of aphids *e.g.* Acyrthosiphon pisum, Aphis craccivora, Aphis fabae, Macrosiphum euphorbiae and Myzus persicae; are the important for transmission of this virus.
- **'Leaf Crinkle'** disease of urdbean is spread by a virus also known as **'Urd leaf crinkle virus'**. Till date, the cause of this disease is not yet known by researches. However, it may be due to virus/aphids/& other insects.
- **'Yellow Mosaic Virus'** disease (or Necrotic mosaic) in mungbean is caused a virus, that is

left by sucking insect or white fly–**'Bemisia tobaci'**.

- The losses in pulse crops yields due to virus diseases may vary from 60 to 80% in general or even upto 100% crop failure, besides affecting seed quality. Such losses due to virus are recorded as;
  - (i) Yellow mosaic virus (Necrotic mosaic) in mungbean & urdbean–80 to 100% reduction in yield.
  - (ii) Leaf crinkle in urdbean– 60-62% loss due to virus.
  - (iii) Sterility mosaic in pigeonpea– 80% loss
  - (iv) Stunt (dwarfness) disease of gram– 59-90% loss.
  - (v) Bean common Mosaic Virus disease–35-98% loss.
- The structure of viruses is very simple, creating disease in plants. These are made-up of only nucleo-protein; and have no structure like cell. The nucleic acid part of virus is infectious/or chronic, and it is said to be the **Genome** of virus.
- Plant viruses are of 3 types–some viruses-isometric or spheroidal, some rodtypes and others basiliform. The diameter of—
  - (i) **Spheroidal Viruses**—17 Nenometer (1neno-meter = $10^{-9}$ m) to 70 nenometer;
  - (ii) **Baciliform Viruses**—100 to 300 nenometer (length), and 50 to 95 nenometer (width).
  - (iii) **Rod Type Viruses**—46 to 215 nenometer (length) and 22 nenometer (width).
- Pigeonpea and some plants like—**Xanthium strumarium**, **Bracharia ramosa; Cosmos bipinnatus** and **Eclipta alba** are also affected due to virus transmission through white fly **(Bemisia tobaci).**
- In pulse crops, Gram–**Heliothis armigera** is a major insect, causing 20-30% yield loss, in general; and in serious attack, 80-90% crop may damage.
- **'Wilt'** disease in gram is caused due to **Fusarium oxysporum** var. (spp)–Ciceri-fungus attack.
- Arhar (Pigeonpea)—**'Wilt'** is spread due **'Fusarium udum'** fungus

**Table**—**'Wilt'** disease & causal organism in crops

| S.No. | Crop | Disease | Causal Organism |
|---|---|---|---|
| 1. | Gram | Wilt | **Fusarium oxysporum var. Ciceri** |
| 2. | Lathyrus | Wilt | **Fusarium arthoceras var. lathyri** |
| 3. | Lentil | Wilt | Fusarium erthoceras **var.** entidis |
| 4. | Pigeonpea | Wilt | Fusarium udum |
| 5. | Linseed | Wilt | Fusarium lini |
| 6. | Sesamum | Wilt | Fusarium vasinfectum |
| 7. | Cotton | Wilt | Fusarium oxysporum **var.** vasinfectum |
| 8. | Sunnhemp | Wilt | Fusarium udum **Var.** Crotolariae |
| 9. | Chillies | Wilt | Fusarium annuum |
| 10. | Pea | Wilt | Fusarium oxysporum f. pisi |

- **'Root-Knot'**—Nematode disease in pulses like-pigeonpea, mung, urd, gram, lentil, pea, rajmash etc. is caused by meloidogyne spp. (nematode); which reduced nearly 15-20% yield.
- Major diseases of Rapeseed–Mustard and their causal organism—

| S.No. | Disease | Disease Kind | Causal Organism |
|---|---|---|---|
| 1. | Alternaria Blight | Fungal | Alternaria brassicae |
| 2. | White Rust | Fungal | Albugo candida |
| 3. | Downy Mildew | Fungal | Pernospora parasitica |
| 4. | Powdery Mildew | Fungal | Erysiphe cruciferarum |
| 5. | Sclerotinia Stem Rot | Fungal | Sclerotinia sclerotiorum |
| 6. | Club Root | Fungal | Plasmodiophora brassicae |
| 7. | Bacterial Rot | Bacterial | Xanthomonas compestris |
| 8. | Bacterial Stalk Rot | Bacterial | Erwinia carotovora |
| 9. | Mosaic | Viral | Turnip virus I Group |
| 10. | Phyllody | Myco-plasmal | Mycoplasma like organi-sms (MLO). |

## Meaning in one Sentence

- **Fungus (Mould)**—The profuse fungal growth on surface of plant tissue or humid or decomposed matter.
- **Apothecium**—The growth structure of some askasy fungus like; open cup or tray shape, having strata/layer of hymenium in inner surface.
- **Anticeptic**—That medicine, which is so strong, kills the bacteria but not to damage to lives *e.g.* Dettol.
- **Biotic-diseases**—White rust, alternaria blight and stem rot are the biotic-diseases.
- **Abiotic Stress**—Drought, salinity and high temperature come in abiotic stress.

## *Multiple Choice Questions*

1. The physiological disease in cotton, which is called **'Tirak'** *i.e.* opening (burst-out) of bolls, is caused due to—
   (A) Light sandy soil, having low in nitrogen, only
   (B) Sandy-loam soil, having sub-soil with salinity, only
   (C) Due to both (A & B)
   (D) None of these
2. Match the following—
   **Famine in Crops**
   (a) In Bengal, **'Brown Leaf Spot'** (Helminthosporium) Famine in rice
   (b) In Ireland, **'Late Blight'** disease in potato, *i.e.* Ireland (Iris) Famine
   (c) In Sri Lanka (Ceylone) **'Coffee Rust'** Famine
   (d) In U.P., **'Red Rot disease'** in sugarcane — Famine
   **Year**
   1. 1845
   2. 1943
   3. 1967
   4. 1938-39

   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 2 | 1 | 3 | 4 |
| (B) | 4 | 1 | 3 | 2 |
| (C) | 1 | 2 | 3 | 4 |
| (D) | 3 | 4 | 1 | 2 |

3. The causal organism of late blight disease in potato is—
   (A) Alternaria solani
   (B) Phytophthora infestense
   (C) Rhizoctonia solani
   (D) Rhizoctonia bataticola
4. In some of the states, it has started to ban on the consumption of **'Khesari' (Lathyrus sativus)**, because of slowly retardation of—
   (A) Eye vision
   (B) In locomotion/movement of lower limbs
   (C) Hearing
   (D) Red blood corpsels (RBC)
5. Which of the disease in plants is caused by bacteria ?
   (A) **'Die-back'** in citrus
   (B) **'Tikka'** in groundnut
   (C) **'Leaf curl'** in tomato
   (D) **'Stem-rot'** in maize
6. In legume crops, the correct order of seed-treatment (correspondingly, say in order of descending *i.e.* first, middle and last) is—
   (A) Rhizobium-culture, Insecticide, Fungicide (RIF)
   (B) Fungicide, Rhizobium-Culture, Insecticide (FRI)
   (C) Fungicide, Insecticide, Rhizobium-culture (FIR)
   (D) Insecticide, Fungicide, Rhizobium-Culture (IFR)
7. Who gave the name **'Crop Lodging'** in sugarcane ?
   (A) C.F., Clement (Hawai)
   (B) H.F. Dastur
   (C) J. Willey
   (D) None of these
8. Dr. K.C. Mehta (Ex-Principal, Agra College, Agra and a well known Plant Pathologist) made a unique contribution in the field of Plant Pathology, who made a research, in

cereals especially, in wheat on the disease cycle of—
(A) Rust (B) Wilt
(C) Smut (D) Blight

9. In potato, the symptoms of seriousness of pathogens in **'Bacterial Brown Rot'** and **'Wilt'** diseases are appeared due to relative production of which matter (subsistance)—
(A) Protein (B) Lipids
(C) Gibberellins (D) Poly-saccharides

10. The causal organism (or Pathogen) of **'Karnal Bunt'** disease in wheat is—
(A) Neovossia indica
(B) Tilletia foetida
(C) Claviceps microcephala
(D) None of these

11. Match the following—
**Disease**
(A) **'Black-leg and Soft-Rot** of potato
(B) **'Damping off'** of vegetables
(C) **'Wilt'** (bacterial) in vegetables
(D) **'Common Scab'** of potato
**Causal Organism**
(i) **Erwinia carotovora**
(ii) **Pythium** spp.
(iii) **Pseudomonas solanacearum**
(iv) **Streptomyces scabies**

12. Match the following—
**Crop**
(A) Green colour of potato tubers
(B) Tomato
(C) Potato leaves
(D) Maize, Rai (Mustard), Wheat
**Toxin**
(i) Benzo-auxins
(ii) Solanin
(iii) Chaconin
(iv) Tomatin

13. Match the following—
**Crop**
(A) Cabbage
(B) Jowar, Limabean, Peach
(C) Pear, Walnut
(D) Onion, Garlic
**Anti-microbial**
(i) Gluco-cynolate
(ii) Allyl di-sulphide
(iii) Gynogenic glucocides
(iv) Para hydrocunon glucocides

14. Match the following—
**Pathogen**
(A) Helminthosporium carbonum
(B) Helminthosporium victori
(C) Helminthosporium medis race–T
(D) Helminthosporium sacchari
**Toxin Produced**
(i) HC–Toxin
(ii) Victorian
(iii) T–Toxin
(iv) HS–Toxin

15. Match the following—
**Disease**
(A) **'Ergot'** in Bajra (Pearlmillet)
(B) **'Hill bunt'** in wheat
(C) **'Flag Smut'** in wheat
(D) **'Tikka'** disease in groundnut
**Pathogen**
(i) Claviceps microcephala
(ii) Tilletia caries / and foetida
(iii) Mycosphaerella spp.
(iv) Urocystis tritici

## *Select —True and False*

1. The causal organism (Pathogen) of **'root-rot'** disease in pea is **'Aphanomyces euteiches'** and this can be removed with the use of mustard group (crucifer tissues)–stem, leaf *etc*. or acts as amendment. (…)
2. The **'Wilt' Verticillium alboatrum)** of potato can be improved by the use of barley straw in soil. (…)
3. **'Black Scurf'** of potato-tuber (Pathogen-**Rhizoctonia solani)** can be controlled by the application (use) of wheat straw, wood-dust and oil-cakes in soil. (…)
4. In U.S.A. (United States of America), the pathogen. Causal organism–**Pseudomonas solanacearum** of tomato can be removed by use of 'Tomato-Sudangrass' crop rotation. (…)
5. The **'Black Root-Rot'** disease of tobacco spreads more under humid and high relative humidity conditions. (…)
6. The **'Wilt'** disease in pea increases in alkali soils. (…)

7. The abundence (excess) of 'Common Scab' disease of potato tubers is found in excess moisture and acid soil conditions. (…)
8. The **'Club Root'** disease of cabbage in found (born) more under acid soil. (…)
9. **'Root-rot'** disease of cotton increases in dry soils or under water deficient condition. (…)
10. Gibberellins are not found in micro-organisms, but are called the common element of green plant. (…)
11. Leeuwenhock of England in the year 1675, made the first microscope for the first time; through which bacteria were described in the year 1883. (…)
12. The facultative parasites are generally saprophytes, but under favourable conditions; by attacking on living plants, they become parasites. (…)
13. In nature, obligate parasite grow only on living plants. (…)
14. **'Khaira'** disease in rice due to deficiency of zinc (Zn); **'Black Heart'** due to adverse $O_2$ relationship and **'Black Tip'** disease of mango caused due to atmospheric impurities like-sulphur-di-oxide ($SO_2$)gas released from Kilns near by mango orchard; are born and these are called non-parasitic or non-infections diseases. (…)
15. Parasitic or infections diseases are spread mainly through fungus, bacteria, virus and nematodes. (…)

## *Fill-up the blanks*

1. In **'Die-Back'** / or **'Whither Tip'** disease, the stem or branches are dried mainly from …to….
2. … parasites are primarily saprophytic in eating mechanism.
3. In citrus, **'Citrus Canker'** disease is caused due to … and the bacterium used to live in canker of standing plant.
4. The **'Stem rust'** in wheat, this disease spreads as ….
5. … DNA does not degrade, whereas; the cytoplasmic DNA, may degrade due to pathogen.
6. The book **'Enquiry into Plants'** is written by …, in which plant diseases are described.
7. A soil borne disease –**'Damping off'** is a … parastic disease.
8. The **'Smut disease'** in pearlmillet, wheat and barley is a … diseased.
9. The main cause of **'leaf mottle'** disease in citrus is due to the deficiency of ….
10. The **'leaf curl'** disease in Chilli, Tobacco, Papaya and Tomato is a … disease.

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (C) | 2. (A) | 3. (B) | 4. (B) | 5. (D) |
| 6. (C) | 7. (A) | 8. (A) | 9. (D) | 10. (A) |

| | | | |
|---|---|---|---|
| 11. (A) (i) | (B) (ii) | (C) (iii) | (D) (iv) |
| 12. (A) (ii) | (B) (iv) | (C) (iii) | (D) (i) |
| 13. (A) (i) | (B) (iii) | (C) (iv) | (D) (ii) |
| 14. (A) (i) | (B) (ii) | (C) (iii) | (D) (iv) |
| 15. (A) (i) | (B) (ii) | (C) (iv) | (D) (iii) |

### True / False

All from (1 to 15) are True (T)

### Fill-up the blanks

1. From **'Tip'** to **'Bottom'** (say backwards to downwards)
2. Facultative
3. Xanthomonas citri
4. Compound Interest
5. Chromosomal
6. Theofrast
7. Facultative
8. Seed borne disease
9. Zn (Zinc)
10. Virus borne / viral

●●●

# 10 AGRICULTURAL ENTOMOLOGY

## *General*

- A proverb-with regard to **'IPM'** (Integrated Pest Management) "The enemy of a enemy is our best friend, then why we should see to destroy our friend insect" *i.e.*, "दुश्मन का दुश्मन हमारा सबसे अच्छा मित्र (दोस्त) होता है, तो तब हम अपने मित्र कीट को क्यों नष्ट हो जाने दें." In other words—'इन्हें प्यार से मारो' अर्थात् 'इन्हें पकड़ो और मारो'
- For the biological control of **'Phalaris minor'** weed in wheat, the use of **'Neem cake'** + **'Trichoderma viride'** reduces the root length of this weed and also inhibits the germination of **'Phalaris minor'.**
- For the control of **Parthenium** weed, marigold reduces its plant roots and also suppress the height of this weed. **Zygogramma bicolorata** insect can destroy the parthenium.
- National Integrated Pest Management Research Centre is situated at IARI, New Delhi.
- In **'Green House'**, the oxygen is not found in plenty.
- The use of B.H.C. (Benzene-Hexa-Chloride) and Gamaxin ($C_6H_6O_{16}$) has been banned, because of harmful effects.
- For termite control, use **Viberia Vivaceana**.
- **'Software-Helicoverpa Forecasting Model'** has been prepared on IPM (Integrated Pest Management); so that relation may possible between pest and weather. The data-base has been collected from five centres of the country. For assessing the damage of Indian crops by exotic/foreign pests and diseases the use of **'Climex Software'** has been done.
- Bio-Intensive Integrated Pest Management has been found to be the cost effective (*i.e.* in Cost : Benefit ratio) compared to traditional methods of the farmers, being used in Andhra Pradesh.
- In Orchards, installing **'Aluminium-GI'** Sheet in 90 cm circle and 60-90 cm above the ground; surrounding to plants/trees has helped not to climb or /creep the squarrels and no damage/loss to fruits.
- For the first time, the insecticides developed and used as; Paris Green in USA (1867), Arsenite in China (1900), Pyrethroids in Caucasus (1800) and Chloropicrin in France (1918).
- In Switzerland, in the year-1939, Muller introduced/searched-out the D.D.T.; Carbamates by the scientist **'Geigy'** of same country in 1947; and parathion in 1944 by Schrader of Germany.
- In India, Lefroy introduced the silk moth and sericulture for the first time at IARI (Indian-now. Imperial-the then) in 1905-06.
- **'Pyrethrum'** and **'Nicotine'** are the plant extracts/or Botanicals (a bio-pesticide content) obtained from chrysanthemum and tobacco respectively.
- Bt **(Bacillus thuringiensis)** bacteria, are more effective and widely used for controlling lepidopterus insects, those are found on crops and wild trees—
- The development of plants of insect-pests resistant transgenic cotton is being developed by transferring **'Bacillus thuringiensis'** of Bt-genes at CICR (Central Institute of Cotton Research), Nagpur (Maharashtra) under Dr. C.D. Mayee, the Director of Institute.
- B.H.C. (Benzene Hexa Chloride) is a fetal and powder insecticide. Its use in agriculture is now banned.
- Bactericide is a substance, which is capable to kill bacteria.
- **'Bio-toxicity'**–a harmful (toxic) influence of the applied substance in plants.
- **'Bordeaux mixture'**—a mixture of copper sulphate, lime and water (4 : 4 : 50 or 5 : 5 : 50 ratio), used as fungicide spray on crop. It is also known as **'Bordo-Mixture'**.
- **'Burgundy Mixture'**—A mixture of copper sulphate ($CuSO_4$) and sodium carbonate (Washing Soda), used as a fungicide.

- Carnivorous plants/or insectivorous plants are those plants, they eat insects *e.g.* Pitcher Plant.
- **'DDT'** was discovered by **'Paul Muller'** in 1939—having insecticidae properties and became most popular.
- Organic–a plant origin, insecticides are Nicotine Sulphate, Pyrethrins, Rotenone and Ryania.
- Organic–a synthetic, insecticides as chlorinated hydrocarbons group are; Aldrin, BHC, DDT, Endrin, Chlorodane, Endosulphan etc.
- Organic–a synthetic, insecticides-as organo phosphate group are; Parathion, Malathion, Phosphomidon, Dimethoate, Monochrotophos, Dichlorovas etc.
- Organic–a synthetic, insecticides-as Carbamate group are; Carbofuran, Carbaryl etc.
- Pesticides Management Bill, 2008—The new Pesticides Management Bill 2008, is intended to replace the Insecticides Act, 1968, to provide more effective and use of pesticides in India.

## Some Famous Previous (Ex) Agricultural Entomologists of India, Worked in Agriculture Sector

1. **Hem Singh Pruthi**—Imperial Entomologist, Ex.-Director–IARI, First Plant Protection Officer, Advisor to Govt. of India, Director Locust Control, India, First Chief Editor, I.J. Entomology (Retd.)
2. **Sardar Singh**—Plant Protection Advisor to Govt. of India, Director Locust Control, New Delhi. (Retd.)
3. **S. K. Sen**—Head, Parasitology & Entomology, IARI, **Author–**Veterinary Entomology and Acarology of India . (Retd.)
4. **R. N. Mathur**—Forest Entomologist, Dehradun. (Retd.)
5. **E. S. Narayanan**—Head, Division of Entomology, IARI, Director-Central Sericulture Research Institute, Mysore (Karnataka) (Retd.)

   **Others**—H.M. Lefroy, S.R. Christophers, Coleman, T.B. Fletcher, Mian M. Afzal Husain, Y. Ramachandra Rao, T.V. Rama Krishna Ayyar, Taskhir, Ahmad, I.M. Puri, Dev. Raj Mishra, M.L. Roonwal, etc. All they worked as Entomologists in India.

**Important Pests of Rapeseed-Mustard**

| Common Name | Scientific Name |
|---|---|
| **(A) Key Pest** | |
| — Mustard Aphid | Lipaphis erysimi (Kalt) |
| **(B) Major Pests** | |
| — Saw fly | Athalia lugens proxima (Klug.) |
| — Painted bug | Bagrada hilaris (Burm.) |
| — Pea leaf miner | Chromatomyia horticola (Goureau) |
| — Bihar hairy caterpillar | Diacrisia obliqua (Walker) |
| **(C) Minor Pests** | |
| — Cabbage butter fly | Pieris brassicae (Linn.) |
| — Flea beetle | Phyllotreta cruciferae (Goeze) |
| — Green peach Aphid | Myzus persicae (sulzer) |
| — Diamond black-moth | Plutella xylostella (Linn.) |
| **(D) New Pests** | |
| — The longer moth | Crocidolomia binotalis (Zeller) |
| — Cabbage top borer | Hellula undolis (Fab.) |
| — Cabbage aphid | Brevicoryne brassicae (Linn.) |
| — White fly | Bemisia tabaci (Gen.) |
| — Termite | Odontotermus obesus (Rambur) |
| — Tarnip moth | Agrotis segetum (Dennis and Schiff) |
| — Gram pod borer | Helicoverpa armigera (Hub.) |
| — Cabbage semi-looper | Plusia orichalsia (Fab.) |

## *Multiple Choice Questions*

1. Honeybees are used for—
   (A) Sericulture (B) Apiculture
   (C) Vermiculture (D) Moriculture
2. Which one of the following is most harmful pest (Insect) for cotton—
   (A) Jassids (B) Pink boll worm
   (C) Spotted boll worm (D) Termite
3. For the control of Aphid in mustard, the quantity of Malathion (5OEC) should be—

(A) 200 ml/ha (B) 100 ml/ha
(C) 1000 ml/ha (D) 500 ml/ha

4. Which parasite can control the stem borer in rice ?
(A) Trichoderma
(B) Trichogramma
(C) Cytobagus salvinia
(D) Neochetina ecornia

5. Which insecticide belongs to **'Carbamate insecticide'** ?
(A) Aldicarb (B) Heptachlor
(C) Malathion (D) Endosulphan

6. **'Bhopal Gas Tragedy'** was caused by which gas ?
(A) Ethane
(B) Methyl Iso-cynate
(C) $CCL_4$
(D) $CHCl_3$

7. Which insect used to attack at night on the rice crop ?
(A) Gundhi bug (B) B.P.H.
(C) Aphid (D) Rice Stem borer

8. **'Turbutryn'** is related to which group ?
(A) Atrazine (B) Fluchloralin
(C) Glyphosate (D) 2, 4–D

9. Which of the element is not phytotoxic ?
(A) Boron (B) Lithium
(C) Florine (D) Silanium

10. How many eggs are laid per day by Queen Honeybee ?
(A) 0·5 – 1·5 thousand
(B) 2 – 3 thousand
(C) 4 – 4·5 thousand
(D) 5 – 5·5 thousand

11. In general, Queen termite lays eggs per second—
(A) 60 (B) 10
(C) 20 (D) 40

12. Phorate - 10 G is a … insecticide—
(A) Systemic
(B) Contact - systemic mixed
(C) Contact
(D) Contact - stomachic mixed

13. Metasystox is an insecticide—
(A) Contact
(B) Systemic
(C) Contact - stomachic mixed
(D) None of these

14. Dwarfness in Sugarcane is caused by—
(A) Virus (B) Bacteria
(C) Insects (D) None of these

15. In sugarcane, by the attack of top-shoot borer—
(A) Leaves become dry
(B) Creats bad - smell in top portion
(C) Roots become dry
(D) Stem becomes dry

16. Match the following—

**Nematodes**
(A) Meloidogyne spp.
(B) Tylenchulus semipenetrans
(C) Heterodera avenae
(D) Heterodera tobaccum

**Related crop / disease**
(i) Root-knot of Tomato, Brinjal / Okra
(ii) Citrus Nematode
(iii) Cereals Root - Nematode
(iv) Tobacco Cyst Nematode

17. Match the following—

**Common Name**
(A) Italian Locust
(B) Red Locust
(C) Brown Locust
(D) South American Locust

**Scientific Name**
(i) Caliptemus italicus
(ii) Cystoserka paranensis
(iii) Locustana pardilina
(iv) Nomadacris ceptamfesiata

18. Match the following—

**Insect**
(A) Pink boll worm of Cotton
(B) Stem borer of Sugarcane
(C) Cut-worm of Gram (Chickpea)
(D) Silk-moth of Mulberry

**Related Family**

(i) Nocteudae
(ii) Pyrilidae
(iii) Bombicidae
(iv) Galichidae

19. Match the following—

**Bee** (Honey bee)

(A) Indian Bee
(B) Sarang Bee
(C) Bhunga / Bhrunga Bee
(D) Damper Bee

**Scientific Name**

(i) Apis dorsata
(ii) Aphis florea
(iii) Aphis indica
(iv) Melipona spp.

20. Match the following—

**Insect**

(A) Lac
(B) Silk worm
(C) Bee (Honey bee)

**Rearing (Host) Plants**

(i) Ber, Kusum (Safflower), **Peepal, Khair,** Flas etc.
(ii) Mulberry
(iii) Mustard, Eucalyptus, Berseem, Lucerne, Sunflower etc.

## *Select —True and False*

1. The causal Organism of Potato Cyst Nematode (disease) in potato crop is **'Globodera rostochiensis'** nematode. (…)
2. In Sugarbeet, the cause of cyst nematode disease is **'Heterodera sachachtii'** nematode. (…)
3. Malathion pesticide is a contact & stomach-poison. (…)
4. Most nematodes (except, Heterodera avenae) grow higher on pH 5-6, that create **'Molya'** disease in wheat and bareley. (…)
5. In Silk-worm, flechary and gerecery diseases are spread by bacteria. (…)
6. Acarine and paralysis diseases are appeared in Honey bees. (…)
7. Ants make losses by eating honey, entering into comb of honeybees. (…)
8. The **'Locust Destructive Act'** was accepted in the year 1951. (…)
9. The **'Destruction of Field Rats'** Planning / programme was started in the year 1957. (…)
10. The Central Directorate of Plant Protection, Quarantine & Storage was established on the recommendation of First Plant Protection Officer and Advisor to Govt. of India — Dr. Hem Singh Pruthi. (…)

## *Fill-up the blanks*

1. 'Paris Green' is a ….
2. The Light Trap is used to attract … type of insects.
3. Most pesticides are … in water.
4. Those pesticides, used in gas form, are called ….
5. Honeybees consume (eat) … from hive (comb), if the temperature falls-down in winter.
6. If atmospheric temperature exceeds to … °C, then honeybees collect water, in place of pollengrains, so as to make hive–(comb) cool and air-conditioned.
7. Marigold **(Tagetes erecta)** is used to control … in bio-control method.
8. In general, insects like … , are disease carrier or vector.
9. Hairy root (bearding/or witche's broom) disease is caused by … type of nematode.
10. Cucurbitacin compound is produced from cucurbits-bitter cucumber, that acts as repulsion of ….
11. The full name of D.D.T. is ….
12. Two important diseases of silk-worm are … and … .
13. India became the member of International Plant Protection Organization in the year….
14. The *'Destructive Insects and Pests Act'* in the country was constituted in the year ….
15. The complete word of **'IPM'** is ….

# ANSWERS

## Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (B) | 2. (B) | 3. (C) | 4. (B) | 5. (A) |
| 6. (B) | 7. (A) | 8. (A) | 9. (A) | 10. (B) |
| 11. (A) | 12. (B) | 13. (A) | 14. (A) | 15. (B) |

16. (A) (i) (B) (ii) (C) (iii) (D) (iv)
17. (A) (i) (B) (ii) (C) (iii) (D) (iv)
18. (A) (iv) (B) (ii) (C) (i) (D) (iii)
19. (A) (iii) (B) (i) (C) (ii) (D) (iv)
20. (A) (i) (B) (ii) (C) (iii)

## True / False

All (from 1 to 10) are True (T)

## Fill-up the blanks

1. Copper Aceto Arsinate
2. Night - Noctoral
3. Insoluble
4. Fumigents
5. Stored Honey
6. 35°C
7. Nematode
8. Aphids
9. Necobus spp.
10. Nematodes
11. Di-chloro Di-Phenyle Tri-Chloro-ethane
12. Virus Pevarine and Protozoan Pevarine
13. 1951
14. 1914
15. Integrated Pest Management

| Agriculture Related Days per year Celebrated | |
|---|---|
| ● World Environmental Day—5 June. | ● World Day to Combat Desertification & Drought—17 June. |
| ● World Watershed Day—2 Feb. | ● World Hydrography Day—21 June. |
| ● National Science Day—28 Feb. | ● Rose Day—25 June. |
| ● World Consumer Claim Day—15 March. | ● World Statistics Day—29 June. |
| ● World Forest Day—21 March. | ● **International** Day for Co-operative—7 July. |
| ● World Day for Water (by UNO)—22 March. | ● National Afforestation Day—28 July. |
| ● World Meteorological Day (by W.M.O.-World Meteorological Organization)—23 March. | ● National Nutrition Week—1-7 Sept. |
| | ● World Coconut Day—2 Sept. |
| | ● Pumpkin Day—29 Sept. |
| ● Water Resource Day—10 April. | ● World Animal Welfare Day—4 Oct. |
| ● World Earth Day—22 April. | ● World Wild Animal Day—6 Oct. |
| ● World Veterinary Day—28 April. | ● UN International Day for Natural Disaster Reduction—11 Oct. |
| ● Anti-child Labour Day—30 April. | |
| ● International Labour Day—1 May. | ● World Food Day/World Food Prize Day—16 Oct. |
| ● National Technology Day—11 May. | ● International Poverty Eradication Day—17 Oct. |
| ● International Bio-diversity Day—22 May. | ● World Environment Protection Day—26 Nov. |
| ● Common Wealth Day—24 May. | ● National Pollution Control Day—2 Dec. |
| | ● International Broadcasting Day—10 Dec. |
| ● World No Tobacco Day (Theme—Tobacco free youth). | ● Kisan Divas—23 Dec. |
| | ● National Cunsumers Rights Day—24 Dec. |

| Agricultural Census in India (w.e.f. Ist 1970-71 to 8th—2005-06) |
|---|
| I-1970-71, II-1975-76, III-1980-81, IV-1985-86, V-1990-91, VI-1995-96, VII-2000-01, VIII-2005-06 (last) (5 years Interval) |

●●●

# 11 AGRICULTURAL ECONOMICS

## *General*

- **Establishment Year of the Following—**

| Year | Institutions / Programmes (set-up) |
|---|---|
| 1939 | Rationing system was started for the first time in the country at Mumbai (the then Bombay) |
| 1952 | **'GROW MORE FOOD'** Compaign-started |
| 1965-66 | 'Save Grain Compaign'–initiated |
| 1966 (Dec. 24) | First–National Commission on Labour |
| 1982 (March) | **'NERAMC'** Ltd. (North-East-Region Agriculture Marketing Ltd.), **Guwahati** (Assam) |
| 1984 | Rice Processing Research Centre, Thanjavur (T.N.) |
| 1985 (May) | Indira Awaas Yojana |
| 1986 | **'CAPART'**–Council for Advancement of People's Action & Rural Technology |
| 1986 | Central Rural Sanitation Programme |
| 1986 (May) | Technology Mission on Oilseeds (TMO) under Ministry of Agric.-Set-up |
| 1987 (July) | Consumer's Protection Law |
| 1988 | National Agriculture Marketing Institute (Earlier name–Agriculture Marketing Centre) |
| 1988 | Ministry of Food Processing Industry |
| 1985-90 | Integrated Wastelands Development Programme (IWDP) |
| 1990-91 | **'NWDPRA'**–National Watershed Development Project for Rainfed Areas |
| 1992 | Self-Help Group (SHGs)–Bank Linkage Programme |
| 1993 (Oct.) | Power of Selling **Wheat** in open Market to FCI (Food Corporation of India) |
| 1994 (Jan.) | Power of Selling **Rice** in open market to FCI |
| 1994 | Small Farmers Agri-business Consortium (SFAC) and started function from 1998 |
| 1994-95 | Rural Infrastructure Development Fund (RIDF) in **'NABARD'** (12 July, 1982 est.) |
| 1996-97 | Accelerated Irrigation Benefit Programme (AIBP) |
| 1997 | Sugar Export Promotion Act. (1958, Cancelled, January) |
| 1999 (April) | District Rural Development Agency (DRDA) |
| 1999 (April-1) | Samagra Awaas Yojana |
| 1999 (April-1) | Credit-Cum-Subsidy Scheme (CCSS) for Rural Housing |
| 1999 (April-1) | Swaranjayanti Gram Swarojgar Yojana (SGSY) |
| 1999 (April-1) | Samagra Awaas Yojana |
| 1999 (April-1) | Jawahar Gram Samradhi Yojana (JGSY) |
| 2000 (April-1) | Pradhan Mantri Gramodaya Yojana (Gramin Awaas)–PMGY |
| 2000 | Janashree Bima Yojana |
| 2000 (Dec. 25) | Pradhan Mantri Gram Sadak Yojana (PMGSY) |
| 2001 (April) | Grameen Bhandaran Yojana |
| 2002 (Dec.) | Agricultural Insurance Company (AIC) |
| 2002 | Gramin Bhandar Yojana |
| 2002-2003 | Bandhak Rin Guarantee Yojana |
| 2002-2003 | Janraksha Bima Yojana |
| 2002 | Nirmal Bharat Abhiyan Yojana |
| 2002 | Bima Gram Yojana |
| 2002 | Population First Yojana |
| 2002 (15 Aug.) | Ansdayee Bima Yojana |
| 2002 (15 Aug.) | Nirmal Bharat Yojana |
| 2003 (Declared) | **PURA**—Programme on Provision of Urban Amenities is Rural Areas. |
| 2003 (27th Jan.) | Hariyali Yojana |
| 2003 | Credit Card Yojana—for Hastashilpies |

| | |
|---|---|
| 2004 (1 Oct.) | National Project on Promotion of Organic Farming |
| 2004 (Nov.) | National Agricultural Science Museum of the NARC (ICAR) |
| 2004 (23 Jan.) | Social Protection Pilot Yojana (for Non-organized labourers) |
| 2005 (1 April) | Rajeev Gandhi Labour Welfare Yojana |
| 2005 (1 April) | Janani Suraksha Yojana |
| 2005 (16 May) | Bharat Nirman Yojana |
| 2006 (Jan.) | National Mission on Micro-Irrigation |
| 2008 (1 April) | National Rural Employment Guarantee Scheme-2005—Started from 1 April, 2008 at All India level with combin food for Work & SGRY. |
| 2010 (July) | Accelerated Pulse Production Programme (A 3 P) |
| 2011-12 | New Scheme on Vegetable Initiative for Urban Clusters (Under RKVY—Rashtriya Krishi Vikas Yojana) |

- Nationalization of Banks–On 19 July, 1969.
- **'Agriculture Price Commission'**—Implemented in 1965.
- Meaning of Economics—Law of House hold Management and formed by two words–Oikas = Home and Nomos = Law; Whereas the meaning of Agricultural Economics – is the management of eco-management in agriculture.
- Famous Economist **'Marshall'** defined **'Principles of Economics'** in book Economics Subject is the physical welfare of man; while **'Robbins'** has defined the economics in his words – Economics is the Science, that deals with the behaviour of human, under limited resources, their optional or alternative uses are possible and is related to targets.
- **Wants**—The desire, ability to complete it and has quickness or of its uses (*i.e.,* Wants = Desire + Resources + Quickness)
- Seeds, Fertilizers / Manures, irrigation water, labour etc. are the working capital or cost whereas, buildings, machinery etc. on a farm are considered in fixed – cost / capital.
- Agriculture Cost and Price Commission (ACPC) was constituted in 1965, and the Indian Food Corporation (IFC) was also set-up in 1965.
- In U.P., the work on **'Zamindari Reform'** was started on July 1, 1952.
- All India Rural Credit Survey Committee was constituted in 1951 by Reserve Bank of India.
- In India, the climax Institute of Co-operative Marketing System is National Co-operative Marketing Federation.
- The Head Quarter of World Bank is Washington–D.C.
- As per Agricultural Census (1990-91), (i) Marginal Holdings (less than 1 ha) with an average of 0·40 ha; (ii) Small Holdings (1 to 4 ha)-av. 1·98 ha; (iii) Medium Holdings (4 to 10 ha)-av. 5·88 ha, (iv) Large Holdings (above 10 ha)–av. 17·16 ha and Total a verage 1·57 ha; while in Gujarat, the av. holding was 2·93 ha and in Kerala-0·33 ha. The States, those were found below the National Average holdings—H.P., Bihar, Assam, Tamil Nadu, West Bengal, U.P., J & K and Kerala; and above national average holdings–Rajasthan, Maharashtra, Gujarat, M.P., Haryana, Punjab, Karnataka and Andhra Pradesh.
- In 1994, the per family holding in India was 4·5 acre, whereas it was 7·5 in Punjab, 7 in Rajasthan and Gujarat, 6·5 in M.P., 6·3 in Maharashtra and 0·9 acre in Kerala.
- Presently, the average land holding of marginal farmer is 1·3 acre; Small–3·8, Medium–7·5 and large farmer–21·8 acres.
- In the country, National Pulse Technology Development Project was started in 1990, that has spread over a large area, comprising in 304 districts of the country with 75 : 25 (Central : State share) expenditure.
- National Agricultural Science Museum of NARC (ICAR)—Inaugurated by Dr. A.P.J. Abdul Kalam, the President of India—On Nov., 3, 2004, at New Delhi.
- In World, the rank of India is as;
  - Tea, Jute, Mango, Cashew, Banana, sesamum *(Til)*, Milk and Cattle population—as I Rank
  - Groundnut, Castor, Arable land, Rice, Rapeseed, Fruits and Goat population—as II rank
  - Cereals, Cotton and Coconut—as III rank
  - Coarse grain and Tractor—as IV rank
  - Whereas, in irrigation potential, India's rank is first (highest).

- India's share in world market of spices is about 18%.
- The maximum area under pulses in the world is in India.
- The Government of India declares each year and fixes the minimum support price (MSP) of 24 major crops, looking to the welfare and need of self-sufficiency of farmers; like; rice, wheat, jowar, bajra, maize, ragi, oilseeds, coconut, cotton, jute, sugar and tobacco.
- During the crop year 2004-05, the minimum support price (MSP) of wheat is fixed Rs. 640 and of gram Rs. 1425 and Rs. 1700 per quintal of mustard.
- Total Cost = (Total Variable Cost + Total Fixed Cost)
- Average Fixed Cost (AFC)

$$= \frac{\text{Total Fixed Cost}}{\text{Number of Units of Output Produced}}$$

- Average Variable Cost (AVC)

$$= \frac{\text{Total Variable Cost}}{\text{Number of Units of Output Produced}}$$

- Average Total Cost (ATC)

$$= \frac{\text{Total Cost}}{\text{Number of Units of Output Produced}}$$

- Marginal Cost $= \frac{\Delta TC}{\Delta q}$

  where, $\Delta TC$ = Increase in Cost;

  $\Delta q$ = Increase in Output.

  **Note** —The Marginal Fixed Cost (MFC) is always Zero.
- Marginal Product (MP)

$$= \frac{\Delta Y}{\Delta X} = \frac{\text{Change in Total Output}}{\text{Change in Input}}$$

- Law of Average Product (LAP) $= \frac{Y}{X}$,

  where, Y = Total Product

  X = Total Input
- **'NABARD'** (National Bank of Agricultural and Rural Development)—**'NABARD'** was established on 12 July, 1982, having the main objectives—to support and improving the 'Agriculture and Rural Development'. **Ist** Chairman—was M. Ram Krishnayya
- **Law of Diminishing Returns / or Law of Diminishing Marginal Returns**—The increase in any crop produced by a unit increment of a deficient factor is proportional to the decrement of that factor from the maximum. / or in other words; As the amount of labour and capital on a unit land is increased, the increase in production, that is also called marginal increasing return, decreases continuously, compared to parallel rate.
- **Opportunity Cost / or Principles of Equi-Marginal Return**—If each unit of labour, capital and land is used in such a way, so that maximum extra production (added or marginal return) is obtained, then maximum profit will be achieved.
- For successful management of any project, adopt **'4M Programme'**—**M**-Material, **M**-Man power, **M-**Money and **M**-Marketing and **M5**-Monitoring.

## Meaning in One Sentence

- **Diversified Farming**—A farm on which no single product or source of income equals as much as 50% of the total receipt.
- **Cost**—Outlay of funds for product service, while, **Fixed Cost**—do not change as output changes.
- **Variable Cost**—Expenses of farming, that are involved in production, *e.g.* labour, fertilizer, seed etc. — cost on purchase of these inputs.
- **Total Cost**—Total variable cost plus total fixed cost, is called total cost.
- **Input-Output Relationship**—Working-out the relationship between various inputs of production (seed, fertilizer, labour etc.) and outputs (wheat, rice, milk, meat etc.)
- **Base Year**—In different types of statistical calculations, keeping the base of a certain year, the calculations of other years are done, is called base year.
- **Short-Term Loan**—The loan, which is taken for a period of 3 to 12 months, generally meant for the purchase of variable inputs.
- **Face Value**—Output / or account value of stock and share, on which value, the shares are issued, that is the face value of share.
- **Fixed Capital**—That part of capital, invested on the purchase of permanent resources (machinery, raw material, tools, buildings of factory etc.) of the production, is called fixed Capital.

- **Economic Yield**—Economically useful part of total dry matter production produced by a plant or crop in unit land area, *e.g.,* tubers in potato, grain in wheat etc.
- **Economic Efficiency (Water)**—It is the ratio of actual income (net or gross income) obtained with operating irrigation system, compared with the income expected under ideal conditions.
- **Subsidy**—The capital (or sum) received from Government to the producers / or distributors for keeping the prices / costs on reduction or on fixed level.
- **Overhead Cost**—Those cost, that do not reduce or rise along with production in short period, but that remains even on no production *e.g.,* rent of a factory, interest on old loans etc.
- **Loan**—The (loan) money borrowed from others by a person, company, Government or other Institutions.
- **Agro-Based Industries**—Those enterprises, wherein agricultural products are used.
- **Long Term Loan**—The loans, those are given for the period of 10 years or for long (more) duration.
- **Secondary Market**—The markets located in Tahsil head quarter (H. Q.) or in large towns are called secondary market.
- **Subsistence farming**—The system (management) of farming, wherein people grow crops only for their own purpose (consumption) but, not for sale in the market by producing extra foods.
- **Fixed Cost**—Some components of costs, those are not changed in a fixed time, (like land rent, while working-out the cost of cultivation of crops).
- **Variable Cost**—Those costs, which are varied in amount of out-put in a specified period, as per the changes.
- **Budget**—A details of estimated income and expenditure for any given future period.

## Abbreviations

- **AIBP**—Accelerated Irrigation Benefits Programme (1996-97).
- **AMDP**—Accelerated Maize Development Programme.
- **APMC**—Agricultural Produce Marketing Commodities.
- **CACP**—Agriculture Cost and Price Commission (named in 1985 given by commission for Agricultural Costs & Prices after ACP (Agric. Cost Price) (1965)
- **CADP**—Command Area Development Programme (1974-75) & re-structured as **CADWM**—Command Area Development & Water Management w.e.f. 1 April, 2004.
- **CAM**—Centre for Agricultural Marketing (1988).
- **CAPL**—(Corp Agriculture Produce Loan Scheme)-a new Agric credit Scheme w.e.f. 1 April, 2005.
- **CCIS**—Comprehensive crop Insurance Scheme (Rabi 1999-2000).
- **CIDP**—Integrated Cereal Development Programme.
- **CI**—Crop Insurance (1973).
- **CPP**—Crop Production Programme / Cow Pit Pet method.
- **CWDP**—Comprehensive Watershed Development Project.
- **DARE**—Department of Agricultural Research & Education.
- **DIPA**—Directorate of Agriculture Information and Publications.
- **DNA**—De-oxy-ribo Nucleic Acid.
- **DMI**—Directorate of Marketing and Inspection.
- **DPAP**—Drought Prone Areas Programme.
- **DST**—Department of Science & Technology.
- **ECA**—Essential Commodities Act (1955).
- **EEC**—European Economic Community.
- **FAO**—Food and Agriculture Organization.
- **GATT**—General Agreement for Trade & Tariff.
- **HWS**—House for Weaker Section.
- **HYV'sP**—High Yielding Varieties Programme.
- **IAAP**—Intensive Agricultural Area Programme (1964-65).
- **IADP**—Intensive Agricultural District Programme (1961-62).
- **'ICDP'**—Intensive cotton Development Programme (now modified as Mini Mission-II of Technology Mission on Cotton)-2008-09.
- **ICRISAT**—International Crop Research Institute for Semi-Arid Tropics (Pattancheru, Hyderabad).

- **IDA**—International Development Agency.
- **INM**—Integrated Nutrient Management.
- **IRDP**—Integrated Rural Development Programme.
- **IRRI**—International Rice Research Institute.
- **IVLP**—Institutions Villages Linkage Programme.
- **IWDP**—Integrated Watershed Development Projects.
- **KCCS**—Kisan Credit Card Scheme (1998).
- **KGK**—Krishi Gyan Kendra.
- **KVK**—Krishi Vigyan Kendra.
- **MIS**—Micro Irrigation Scheme (29 Dec., 2005).
- **MKM**—Mitra Krishak Mandal.
- **NABARD**—National Bank for Agriculture and Rural Development.
- **NADY**—National Agriculture Development Yojana (16 Aug., 2007 for 5 yrs).
- **NARP**—National Agriculture Research Project.
- **NARS**—National Agriculture Research System.
- **NBM**—National Bamboo Mission (2 Nov., 2004).
- **NCDC**—National Co-operative Development Corporation.
- **NCIWRDP**—National Commission for Integrated Water Resources Development Plan (Sept. 1996).
- **NFSM**—National Food Security Mission.
- **NHM**—National Horticulture Mission (5 May, 2005).
- **NIAM**—National Institute of Agricultural Marketing.
- **NPDP**—National Pulses Development Project.
- **NPFM**—National Programme of Food Management (1954).
- **NRCE**—National Research Centre on Equines (Hissar).
- **NREP**—National Rural Employment Programme.
- **NWB**—National Water Board (Sept. 1990).
- **NWDPRA**—National Watershed Development Project for Rainfed Areas (1990-91).
- **NWRC**—National Water Resources Council (March 1983).
- **OPP**—Oilseeds Production Programme.
- **PAWDI**—Peoples Action for Watershed Development Iniciatives.
- **RLEGP**—Rural Landless Employment Guarantee.
- **SFCI**—State Farms Corporation of India.
- **SLPP**—Special Live-stock Production Programme (1975-76).
- **T & V**—Training and Visit system.
- **TRYSEM**—Training of Rural Youth for Self-Employment.
- **UNDP**—United Nations Development Project.
- **VBY**—Varsha Bima Yojana (2004).
- **WA**—Women in Agriculture.
- **WDPSCA**—Watershed Development Project in Shifting Cultivation Areas.
- **WQAA**—Water Quality Assessment Authority (29 May, 2001).
- **WTO**—World Trade Organization.

## *Multiple Choice Questions*

1. Match the following—

**Commission / Unit (Govt. of India)**

(a) APC—Agriculture Price Commission

(b) CAPC—Agric. Cost & Price Commission

(c) NAFED

(d) NCDC (National Co-operative Development Corporation)

**Establishment Year**

1. 1985 2. 1958

3. 1963 4. 1965

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 1 | 3 | 2 |
| (C) | 4 | 1 | 2 | 3 |
| (D) | 2 | 3 | 4 | 1 |

2. The contribution (Share) of Agriculture Forestry and Fisheries sectors in G.D.P. (during 2011-12) was noticed.

(A) 50% (B) 17·3%

(C) 43% (D) 35%

3. The contribution (Share) of Agriculture in Total Export Income of the Country is (Approx.)—
   (A) Half $\left(\frac{1}{2}\right)$ (B) One third $\left(\frac{1}{3}\right)$
   (C) One Fourth $\left(\frac{1}{4}\right)$ (D) $\frac{1}{6}$th part
4. How much percentage of labour force of the country is dependent on agriculture for their livelihood ?
   (A) 80% (B) 70%
   (C) 64% (D) 50%
5. How many farmers (nearly) are engaged in Agriculture of the country, those provide food for nearly one billion people ?
   (A) 100 Million (B) 50 Million
   (C) 30 Million (D) None of these
6. 'All India Handicrafts Board' was established in the year—
   (A) Nov. 1952 (B) Nov. 1962
   (C) Nov. 1972 (D) None of these
7. 'All India Khadi & Gramodhyog Board' (AIK & G Board) was established on—
   (A) Feb. 1953 (B) Feb. 1963
   (C) Feb. 1973 (D) None of these
8. Indian Industrial Development Bank (IDBI) was established on—
   (A) July 1960 (B) July 1964
   (C) July 1970 (D) None of these
9. When 'Contract Labour Regulation & Abolition Act' (CLRA) came in force ?
   (A) 1970 (B) 1960
   (C) 1980 (D) 1990
10. Which one is false ?

| | Programme | Establishment Year |
|---|---|---|
| (A) | Mega City Plan | 1993-94 |
| (B) | Rural Games Programme | 1970-71 |
| (C) | Youth Development Centre (Established) Yojana (for group of each 10 Villages) | 1994-95 |
| (D) | Arjun Award Established | 1993 |

11. Match the following—

**Programme**

(a) National Co-operative Development Corporation
(b) Live-stock Insurance Programme
(c) National Land use & Conservation Board
(d) Women Programme (Mahila Yojana) in Agriculture Sector

**Establishment Year**

1. 1963 2. 1974
3. 1983 4. 1993

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 1 | 2 | 3 |
| (C) | 3 | 1 | 4 | 2 |
| (D) | 2 | 3 | 1 | 4 |

12. Match the following—

**Programme**

(a) Kisan Credit Card Yojana
(b) Wide Crop Insurance Yojana
(c) Integrated Watershed Development Project (by World Bank)
(d) Agricultural Economic-Research Study Yojana

**Initiated Year**

1. 1998 2. 1993
3. 1991 4. 1954-55

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 3 | 4 | 1 |
| (C) | 1 | 3 | 4 | 2 |
| (D) | 2 | 3 | 1 | 4 |

13. The major component of Farm Management is—
   (A) Farm Lay out
   (B) Farm Budgeting
   (C) Marketing of Produce / Product
   (D) Production Unit
14. Apex Bank in Agriculture sector is—
   (A) NABARD (B) S.B.I.
   (C) P.N.B. (D) None of these
15. The fixed Capital of Agriculture Farm is—
   (A) Bullock (B) Tractor
   (C) Building (D) None of these
16. The working capital of a farm is—
   (A) Fertilizers (B) Irrigation water
   (C) Seed (D) All above

17. The main function of **'NABARD'** is—
    (A) Development of Agriculture
    (B) For arranging re-finance to the Institutions, providing Agriculture finance
    (C) To provide loan to the farmers for Agriculture
    (D) None of these
18. The first chairman of **'NABARD'** was—
    (A) M. Ram Krishannaya
    (B) Man Mohan Singh
    (C) Jag Mohan
    (D) None of these
19. The farmers having land below one hectare, are said—
    (A) Marginal Farmers
    (B) Small Farmers
    (C) Medium Farmers
    (D) Large Farmers
20. The nature of Agriculture Economics is—
    (A) Real (True) Science
    (B) Modern Art and Science
    (C) Modern Science
    (D) Modern Art

## *Select —True and False*

1. The unit of Agriculture Cost is Rs./ha. (…)
2. The unit of Agriculture Production Expenditure is Rs. /q. (…)
3. Capital and Sum (property) both are not the factor of Agriculture Production. (…)
4. The 'Regional Rural Banks' were established in 1975. (…)
5. 'More Tree Plantation Programme/ Compaign' was started by K.M. Munshi. (…)
6. The achieved production in a certain period by the use of resources, is called output. (…)
7. The alternative/or conventional term for expenditure or cost is called outlay. (…)
8. The source of capital collection by the Joint Capital Company is called **'debenture'**. (…)
9. The branch of Economics, explaining / dealing with agriculture related problems and analysis of agriculture related economic activities, is called 'Agriculture Economics'. (…)
10. The extra (additional) working hours of alloted working time in service conditions of employment, are not called **'Over-time'**. (…)
11. Growing the same crop every year on a certain field, is called **'Mono-cropping'**. (…)
12. The expansion / extension of National income, is called Economic Growth. (…)
13. Co-operative Improved Farming, Co-operative Joint Farming, Co-operative Tenant Farming and Co-operative Collective Farming are considered in Types of Co-operative Farming. (…)
14. According to Grap "Farm Management is an art of successful management of a farm that is measured by profit." (…)
15. Real wages are always higher than cash wages. (…)

## *Fill-up the blanks*

1. The collection / or storage of any material / or goods is called ….
2. For indicating the changes in total cost for any unit in the quantity of output is called ….
3. The declaration of minimum price for sale before the completion of agricultural crops (Pulses, oilseeds, Foodgrains etc.) by the Central Government is called ….
4. The extra sum (money) charged over principal sum (money) taken as loan is called ….
5. "The situation in respect of employment-sector is more unsatisfactory". This statement with regard to employment policy is accepted in (which) … Five Year Plan ….
6. In India, in the year 2003, the estimated is done for the per capita per day availability of foodgrains, being ….
7. The formula used for working-out the labour efficiency, is ….
8. Agriculture Cost = working Cost + ….
9. Agriculture Production Expenditure = Working and Fixed Cost + ….
10. On the farm, fixed cost includes; Expense for repairs and maintenance on fixed cost + ….
11. Rural Banks receive credit from ….
12. Agriculture Production × Cost … .
13. Regional Rural Banks were established in the year ….
14. Food Corporation of India (FCI) was established in the year … (January).

15. The loan given to the farmers for … arranging fertilizers, seeds and implements used in irrigation.

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (C) | 2. (B) | 3. (D) | 4. (C) | 5. (A) |
| 6. (A) | 7. (A) | 8. (B) | 9. (A) | 10. (D) |
| 11. (A) | 12. (A) | 13. (B) | 14. (A) | 15. (D) |
| 16. (D) | 17. (B) | 18. (A) | 19. (A) | 20. (B) |

### True / False

3 and 10 False and Rest True

### Fill-up the blanks

1. Stock
2. Marginal Cost
3. Support Price
4. Interest
5. 6th
6. 438·2
7. Labour efficiency

$$= \frac{\text{Amount of Completed Work}}{\text{No. of labourers engaged}}$$

Or,

$$= \frac{\text{Output of Work}}{\text{Labour Input}}$$

8. Fixed Cost
9. Marketing expenditure
10. Depreciation
11. Lead Bank
12. Gross Farm Income
13. 1975
14. 1965
15. Short Term

| Tips for Future Agriculture |
|---|
| **Problem & Suggestions to Overcome** |
| → Loosing Soil Fertility—Adopt proper crop rotation (Cropping Systems) & Soil Testing be promoted. |
| → How to retain—Integrated use of organic manures & fertilizers |
| → Rain water conservation/Irrigation Manage—Adopt Watersheeds/Drip (Trickle Irrigation/Sprinkler Irrigation—Adopt new Agro-techniques-Improved Varieties |
| → Contract farming—be stopped |
| → Fertilizer Subsidy be given to farmers directly & not to give factory owners. |
| → Crop diversification (Crops/Horticultural/Medicinal/Aromatic crops) is needed. |
| → Agro-based small Industries—by farmers be done to reduce load on Agriculture (as 70% population depends on Agrculture–as livelihood) |
| → Both top-down (↓) & bottom up (↑) Scientific approach to farmers (crop demo etc.)—be adopted |

| New Agricultural Programmes/Schemes |
|---|
| ● National Food Security Mission (NFSM) (Centrally Sponsored Scheme)-w.e.f. Rabi 2007-08 to 11th Plan end to enhance rice, wheat & pulse production by 10, 8 & 2 million tonnes respectively. |
| ● Rashtriya Krishi Vikas Yojana—w.e.f. 2007-08 for 11th Plan to achieve 4% annual growth in agriculture—A new-State Plan Scheme with ACA (Additional Central Assistance) |
| ● New Schemes Under TMOP (Technology Mission on Oilseeds, Pulses & Maize (launched TMO in 1986)—<br>(i) OPP (Oilseeds Production Programme)<br>(ii) NPDP (National Pulse Development Project)<br>(iii) AMDP (Accellerated Maize Development Programme)<br>(iv) PHT (Post Harvest Technology)<br>(v) OPDP (Oil Palm Development Programme)<br>(vi) NOVOD (National Oilseeds & Vegetable Oils Development Board) |
| ● Mini—Mission-II of the Technology Mission on Cotton-contd. during 2008-09 (modified name of ICDP—Intensive Cotton Development Programme (Centrally Sponsored Scheme) |
| ● **'NHM'** (National Horticulture Mission) w.e.f. May, 2005 under NHB (National Horticulture Board) |
| ● **MIS** (Micro Irrigation Scheme)—launched during **'10th'** Plan on 29 Dec. 2005-Centrally Sponsored Scheme. |
| ● **'MMA'** (Macro Management of Agriculture) Scheme, revised in 2008-09 (Centrally Sponsored Scheme) |
| ● National Project on Organic Farming—New Scheme (w.e.f. Oct., 2004) |
| ● **'NRAA'** (National Rainfed Area Authority) Scheme w.e.f. 10 Aug., 2006. |
| ● Share of Agriculture Forestry and Fisheries Sectors in Total GDP—16·3% & in national exports—17·3% in 2011-12 |
| ● AV. growth rate of Agric.—5·8% in 2007-08, 0·4% in 2009-10 and–5·4 in 2010-11 |
| ● Agriculture share in employment in the country-about 52% |

●●●

# 12 AGRICULTURAL EXTENSION

## *General*

- **Ex–**President Dr. A.P.J. Abdul Kalam said for—

  **India Vision 2020** —"A vision is not a Project Report or a Plan Target but, it is an articulation of the desired end results in broader term."

- **India 2020** : A Vision for the New Millennium would help to easy understand that, by 2020, the people of India will be more numerous, better educated, healthier and more prosperous than at any time in our long history.

- Indian Agriculture Development has passed through the **four** stages / or phases till date; *viz*.

| **Phases / Stages of Agricultural Development in India** | | |
|---|---|---|
| 1. | Pre-Green Revolution (1950–65) | Boost in productivity growth of coarse grains and pulses per unit of land. |
| 2. | Green Revolution (1966–67; 1979-80) | Expansion of area and productivity of wheat & rice, improved / HYV's– wide spread adoption, expansion of agric. research / demonstration / education, irrigation development, market out-puts etc. |
| 3. | Post-Green-Revolution (1980–2000) | Continued growth in yield through intensification of fertilizers, labour input, gradual decline in productivity growth, expansion of area under maize, cotton, sugarcane and oilseeds. |
| 4. | Commercialization (w.e.f. 2000… onward) | Further diversification of cropping patterns from low value to high value crops such as; fruits, vegetables, flowers and other horticultural/ medicinal crops for domestic consumption, processing & export. |

- The current, projected food production and demand in the year 2020 would be as under.

**Current & Projected Food Production V/s Demand in 2020** (Million Tonnes)

| | Year | Rice | Wheat | Coarse Cereals | Pulses | Milk | Remark |
|---|---|---|---|---|---|---|---|
| ■ | 2000 | 89 | 76 | 13·6 | 13·5 | 71 | Current |
| ❒ | 2020 BAU | 125 | 108 | 13 | 16 | 181 | Projected |
| ▨ | 2020 BCS | 207 | 173 | 14 | 23 | 203 | Projected |
| ⊡ | 2020 Demand | 119 | 92 | 15·6 | 19·5 | 166 | Demand |

***Source :*** *Based on R. Radhakrishnan and K. Venkata Reddy,* ***'Vision 2020'*** *Food Security and Nutrition— BAU (Business-as-usual); BCS—(Best-case-Scenario).*

- India's population projections in the year 2020 (listed below)—

**India– Population Projections** (Millions)

| Year | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Total | 1010 | 1093 | 1175 | 1256 | 1331 |
| Under 15 yrs | 361 | 368 | 370 | 372 | 373 |
| 15–64 yrs | 604 | 673 | 747 | 819 | 882 |
| 65 + | 45 | 51 | 58 | 65 | 76 |

***Source :*** *Indian Demographic Scenario 2025, – PN Mari Bhatt, Institute of Economic Growth, New Delhi*

- The Status of certified / quality seeds distribution to farmers in India—

| Year | Certified/quality Seeds distribution (in Lac quintal) |
|---|---|
| 2000-01 | 85·44 |
| 2001-02 | 91·00 |
| 2002-03 | 112·00 (anticipated) |
| 2003-04 | 108·39 |
| 2004-05 | 113·01 |
| 2005-06 | 118·52 |
| 2006-07 | 149·63 (targeted) |

- During the more than 50 years of Independence in the country, the agricultural extension approach has been remained **'Top down ↓ Approach'** *i.e.,* **'Lab to Land'** Approach, but in 21st century, this has now to bring-out **'Bottom up ↑ Approach'** *i.e.,* the research has to be bring-out from farmers fields to research laboratory (Land to Lab).

- Rural Development related programmes & establishment year—

| | |
|---|---|
| 1952 (October) | Community Development Programme |
| 1958 (October) | Panchayati Raj |
| 1969 | Rural Electrification Corporation |
| 1970-71 (December) | **DPAP**—Drought Prone Area Programme |
| 1974 | T & V (Training & Visit) programme started in Agriculture Extension |
| 1974-75 | Command Area Development & Water Management Programme |
| 1977 (April) | **Food for Work** Programme |
| 1977-78 (April) | DDP–Desert Development Programme |
| 1978-79 | IRDP–Integrated Rural Development Programme |
| 1984 (April) | JRY–Jawahar Rojgar Yojana (merge of NRIP and RLEPG) |
| 1985-86 | Indira Awas Yojana |
| 1988 (8 Aug.) | 'NIAM'–Ch. Charan Singh National Institute of Agricultural Marketing at Jaipur |
| 1988-89 | 10 lac Wells (Million Wells) Yojana |
| 1990-91 | NWDPRA (National Watershed Development Project for Rainfed Areas |
| 1992 (September) | Panchayati Raj Institution |
| 1993 (October) | Rojgar Guarantee Yojana |
| 1995 (August) | NSAP–National Social Assistance Programme |
| 1998-99 | Kisan Credit Card Yojana |
| 1999 (April) | Jawahar Gram Samradhi Yojana |
| 1999 (April) | SJGSY–Swarn Jayanti Swarojgar Yojana |
| 1999 | Gramin Awaas & Prakratik-Vas Vikas Programme |
| 2002 (March) | On-Farm Water Management Programme |
| 2004 (21 Jan.) | Kisan Call Centres (KCC) |
| 2004 (Nov. 14) | National Food for Work Programme |
| 2005 (April 12) | Janani Suraksha Yojana |
| 2005 (Dec. 16) | Bharat Nirman Programme |
| 2006 (Feb. 2) | National Rural Employment Guarantee Scheme (for at least 100 days wage employment) |
| 2007-08 | Rashtriya Krishi Vikas Yojana (RKVY) |
| 2010 (Kharif) | NFSM (National Food Security Mission)—Covers 476 distt. in 17 states in India |
| 2010 (July) | Participatory Seed Production Programme (**ISOPOM** Scheme) |

- Some World Bank–Aided Watershed Development Projects—
  - 1995 Assam Rural Infrastructure & Agriculture Support Project
  - 1998 DASP–Diversified Agriculture Support Project (in UP–UPDASP, in Uttaranchal also).
  - 2001 (Sept. 10) Comprehensive Watershed Development Project–Karnataka
- 1996-97 AIBP–Accelerated Irrigation Benefit Programme
- 2004 (17 Feb.) Loknayak Jay Prakash Narain Nidhi (Fund) (Agriculture based infrastructure and loan fund). This has taken place RIDF.–activities on- Primary Health Centres, Major & Minor Irrigation Project etc.
- **India's First**—Krishi Vigyan Kendra (KVK) established in 1974 at Pondicherry and of **U.P.** (KVK), the first K.V.K. established in 1976 at Sultanpur.
- In ICAR, at present 2008, Dec., end, there are 569 KVKs (in **8** Zones in India) 97 'ICAR' Institutes and 44 State Agricultural Universities.
- For promotion of Excellence under the ICAR National Professor Scheme, a "Norman

Borlang Chair in Agril. Biotechnology for crop Improvement" has been instituted.

- 'KGK' (Krishi Gyan Kendra) was sponsored by Government of U.P. in Uttar Pradesh.
- The smallest Unit of Extension Education is said to **'Gram Panchayat'**.
- In England, under the Act of 1909, **'Farm Institutions'** were made and in Japan, **'Farm Youth Training Programmes'** were started for the development of Agriculture.
- For the first time, the extension programmes were started from U.S. America.
- Agriculture Extension is that education, in which change is brought-out in knowledge of rural public, skill-understanding in working and attitude, so as to bring permanent improvement in their life-style or living standard.
- In India, the credit goes to Dr. M.S. Swaminathan and in the world to Nobel-laurate Dr. N. E. Borlaug for **'Green Revolution.'**
- In India, First Five Year Plan was started in 1951.
- **RAWE** Programme (Rural Awareness Work Experience) for Agriculture 10 students/-villages in a districts-problem solving and crop demo on farmers field.
- Farmer's Helpline (toll free)—1551 by Govt. of India—Kisan Call Centres—144 at 28 locations (6 am-10 pm)
- **'Sewa Gram'** was established by Mahatma Gandhi, that was the starting / initial Centre of Independence Fight from 1936 – 42. On this place, Mahatma Gandhi called Pt. Jawaharlal Nehru and gave a slogan **'Do & Die'.** In agriculture extension, there is a reference of this **'Sewa Gram'**, located at Wardha in Maharashtra.
- **'King Baudouin Award-2004'** is related to research conducted and development efforts made under partnership in 'Rice-Wheat' consortium lead to International recognition.
- **ICAR Telephone Directory**—(For the year 2004 and 2005) Compiled, edited and computerized by ARIC Agricultural Research Information Centre.
- Electronic Publication by ARIC—Brought-out 5 CDS—Inventory of Indigenous Technology Knowledge (ITK)—Document 1, 2, 2 (Supplement 1), Validation of **'ITK'** in Agriculture-Document 3, and NARD CD (2002-2003) covers Abstracts of articles published in Agricultural Periodicals in India.
- **Father of Community Development Programme in India**—Dr. S.K. Dubey, founded Nilokheri Exptl. Design (Haryana) in 1952.

## Meaning in one Sentence

- **Grow More Food Campaign**—In earlier era from Independence, this campaign was started to produce more foodgrains (Cereals).
- **Group Contact**—Group discussion (or talks) on a plateform like, **Chaupal, Khalihan** etc. places, among the people sit-together.
- **Public Contact**—Extension of informations in rural **melas** (Fairs), so that early message may be sent to most-concern persons.
- **Visual Aids**—These are concerning generally with posters, charts, flesh cards, black-board etc.
- **Audio Visual Aids**—The accessory / material (seen & hear both) used by a extension worker for explaining to rural people, is called audio-visual aid like-Television (T.V.).

## *Multiple Choice Questions*

1. National Programme–**'Improved Chulla's'** was started in the year—
   (A) 1984 - 85 (B) 1994- 95
   (C) 2000 - 01 (D) None of these
2. In which year, Ministry of Non-Conventional Energy Sources was initiated in the year ?
   (A) 1982 (B) 1992
   (C) 1999 (D) 1980
3. In which year, the CDP–Community Development Programme was started ?
   (A) 1947 (B) 1949
   (C) 1952 (D) 1955
4. The success of extension of **'Television Programme'** depends upon—
   (A) Quality of monthly workshop
   (B) Regular visit of VEW–Village Extension Worker
   (C) Quality of fortnightly workshop
   (D) Reaching Correct message upto the farmers
5. In India, **'First'**—State Agricultural University (SAU) was established at Pantnagar in the year—
   (A) 1950 (B) 1960
   (C) 1970 (D) 1975

6. The maximum impact was seen of **'Green Revolution'** achieved in India, on—
   (A) Wheat only
   (B) Rice only
   (C) Wheat and Rice both
   (D) Rice, Wheat and Pulses
7. When **'National Extension Services'** were started in India ?
   (A) 1950 (B) 1953
   (C) 1960 (D) 1970
8. The **'Grass-Root Principle of Agriculture Extension'** is—
   (A) Give the responsibility of extension-work to group of rural people in regional community /group.
   (B) Say; to do extension services to the people in urban sector.
   (C) Giving responsibility of extension work to the people in big cities (Mahanagar).
   (D) None of these
9. The new name of **'VLW'** is now—
   (A) V.D.O. (B) B.D.O.
   (C) R.D.O. (D) Kisan Sahayak
10. The responsibility of **'Gram Sevika'** in the village for rural development is given to educate—
   (A) Women
   (B) Male
   (C) Children
   (D) For all male and female
11. The **'Basic Village Institutions'** are—
   (A) Family, Women Group (Mahila Mandal) and School
   (B) Panchayat, Hospitals and Schools
   (C) Youth Club School and Co-operative Societies
   (D) Panchayat, School and Co-operative Societies
12. **'TRYSEM'** (Training for Self-Employment) was initiated on—
   (A) 15 August, 1979 (B) 15 August, 1970
   (C) 15 August, 1950 (D) 15 August, 1960
13. What is the meaning of A, B, C of Journalism?
   (A) Attractive, Brief and Clear
   (B) Accuracy, Brief and Clarity
   (C) Accuracy, Bravity and Clarity
   (D) None of these
14. **'HYV's'** (High Yielding Varieties) Programme was initiated in—
   (A) 1968 (B) 1960
   (C) 1966 (D) None of these
15. 'National Demonstrations' are called—
   (A) First or Front Line Demonstrations (FLD)
   (B) Second Line Demonstrations (SLD)
   (C) Third Line Demonstrations (TLD)
   (D) None of these
16. Single Line of Command has a special quality—
   (A) Training and Visit (T & V)
   (B) Community Development
   (C) National Demonstration
   (D) Krishi Vigyan Kendra
17. At which place, Ravindra Nath Tagore started the rural welfare work ?
   (A) Pune (B) Sewagram
   (C) Ahmedabad (D) Shantiniketan
18. In India, all round development of poors is only possible things—
   (A) By giving more money
   (B) By making strong rules
   (C) Extension Education
   (D) None of these
19. The element of behaviour is—
   (A) Knowledge and Education
   (B) Skill and Attitude
   (C) Psychology and Aspiration
   (D) Knowledge, Psychology and Efficiency
20. Extension Education may be called—
   (A) Formal Education
   (B) Informal Education
   (C) Applied Education
   (D) Schooly Education

## *Select —True and False*

1. Photographs are considered suitable to teach mainly to educated persons. (...)
2. The Agricultural Extension work was started for the first time in America and Agriculture Development Committee was constituted in the year 1785 at Florida (U.S.A.). (...)
3. On October 2, 1952, 55 Community Schemes were initiated in the country. (...)
4. The target of Agriculture Extension is meant for the knowledge of people, efficiency of working, method and in change of Psychology. (...)
5. The basis of Agriculture Extension are; confidence in himself of man, confidence in freedom and confidence in Science and Technology. (...)

6. Followings are not necessary for the target of Agriculture Extension *i.e.*–management / arrangement of new knowledge for the farmers, management of new agriculture related new methods and solution of agriculture related problems. (…)
7. Following are considered in management of work to fullfill the needs of Agriculture Extension-*i.e.* Agriculture related new knowledge, method and management of education and solution of problems. (…)
8. Agriculture Extension is not a educational process. (…)
9. The job of extension education is to teach (educate) the people. (…)
10. Extension work should be based/oriented-on needs and interest of people. (…)
11. The aim of extension work- is to change/or motivate towards betterment of mankind/progress. (…)
12. We prefer **'Democratic Approach'** in Extension. (…)
13. At rural level, the responsibility of extension work goes on Village Panchayat. (…)
14. In U.S.A., Extension Education is brought as national policy and programmes. (…)
15. The pillar of **'Neelokhedi Experiments'** is said to S.K. De. (…)
16. The beneficiaries of **'I.C.D.S. Programmes'** are mother (s) and children. (…)
17. The charts are used to exhibit facts and ideas through figures, so that the comparison, in brief of subject matter, contrast and explanation may be made. (…)
18. The chronological development of a family can be exhibited very well in the form of **'Tree Chart'**. (…)
19. Extension Education is–the Art and Science both. (…)
20. Man–himself is the basic element for core of Extension Education. (…)

## *Fill-up the blanks*

1. The **'IVLP'**—Institution Village Linkage Programme was started as a **'Pilot Programme / Scheme'** through the assistance of … fund.
2. **'CAZRI'**— Central Institute of Arid Zone Research is located at ….
3. In Agriculture Extension, … system is a best example of training approach, which was initiated first in Israel.
4. The extension work can not be done properly without trained ….
5. The success of extension depends upon the … of men.
6. The extension worker, having higher knowledge and intelligent quotient (IQ) can easily be solved the problems of ….
7. The Welfare Extension Planning (Kalyan Prasaar Yojana) was initiated in the year ….
8. In India, for the first time, **'first'** Centre of Television was established in the year.
9. **'Etawah Pilot Project'** (EPP)—was started in the year 1948 by ….
10. **'Grow More Food Compaign'** was initiated by the Government of India in the year ….
11. **'Rural Development Work in the Villages'** Programme was started in the year 1935 by ….
12. In the Country (India), **'IADP'**–Intensive Agriculture District Programme was initiated in the year ….
13. **'Food for Work Programme'** was started in the year … after Changing National Rural Employment Programme.
14. The origin of **'Extension Education'** was made from the country ….
15. In India, First Agriculture University (UPAU, Pantnagar) was established in the year ….
16. The term **'Extension'** was used for the first time in the year….
17. The working area of National Extension Services Development Block is for about … Villages.
18. In 1926, **'Sewa Gram Programme'** was started by ….
19. For establishing the contact, the best method of extension is ….
20. T & V (Training and Visits) Programme was started by De-Benore in the year ….
21. The **NATP** Project is financed/or funded by ….
22. In the country, the recommendation of KVK was done by … Committee.
23. A good extension work (programme) must be ….
24. The Word Extension Education was originated from the country ….
25. The **'DWCRA'** Programme was started in the year ….

# ANSWERS

## Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (A) | 2. (B) | 3. (C) | 4. (D) | 5. (B) |
| 6. (C) | 7. (B) | 8. (A) | 9. (A) | 10. (A) |
| 11. (D) | 12. (A) | 13. (A) | 14. (C) | 15. (A) |
| 16. (A) | 17. (D) | 18. (C) | 19. (D) | 20. (B) |

## True / False

1, 6 & 8 False and rests— True (T)

## Fill-up the blanks

1. A.P. Cess
2. Jodhpur
3. Training & Visit
4. Specialists
5. Participation & Satisfaction
6. Rural Society
7. On Oct. 2, 1953
8. September, 1959
9. Albert Mayor
10. 1942
11. Ravindra Nath Tagore
12. 1960
13. 1980
14. America
15. 1960
16. 1873
17. 100
18. Mahatma Gandhi
19. Personal Approach
20. 1974
21. World Bank
22. Mohan Singh Mehta
23. Flexible
24. U.S.A.
25. 1983

### Extension Tips-for Successful Extension Working

**Formulae for—**

- **Extension Worker**—**'5 W + 1 H'** (**W**—What, **W**—Why, **W**—Where, **W**—When & **W**—Whom and **1H**—How ?
- **Farmer**—wants **3** Points-**'PSP'** (**P**—Production/Productivity, **S**—Storage & then **P**—Processing)
- **Project Planner**—4M (**M**—Money, **M**—Material, **M**—Man Power & **M**—Marketing)
- **Scientists**—**'5 M'** (4 M—as Project Planner & 5th M—Monitoring)
- **Growing Demand for '5F' in future**—**F**—Food, **F**—Feeds, **F**—Fodder, **F**—Fibre & **F**—Fuel
- **Watershed Project Construction—8M** ($M_1$—Men, $M_2$—Money, $M_3$—Material, $M_4$—Methods, $M_5$—Markets, $M_6$—Movements, $M_7$—Machinery and $M_8$—Message.
- **Service man in Agriculture**—**'3D'** (**D**—Duty, **D**—Devotion/Dedication & **D**—Discipline)
- **Krishak Mitra**—Behave with farmer-as 'FAMILY' (**F**—Father, **A**—And, **M**—Mother, **1**—1 (self), **L**—Love & **Y**—You *i.e.* like Father & Mother 1 love to you (farmer)
- Conserve **FOREST called 'Green Lungs'**—(that gives us)—(**F**—Food, **O**—$O_2$, **R**—Rains, **E**—Environmental Protection, **S**—Soil Conservation & **T**—Timber)
- **$C_7$ for Efficient communication**—$C_1$—Credibility, $C_2$—Content, $C_3$—Context, $C_4$—Clarity, $C_5$—Continuity, $C_6$—Channels of communication & $C_7$—Capability of Audience
- Conserve **6** ज—(**J**—Jal, **J**—Jameen, **J**—Jalwayu, **J**—Jeev Juntu, **J**—Jansankhya & **J**—Jameer (Self-reputation)
- **'BIOFARM'**—**B**—Biological, **I**—Integration, **O**—Of, **F**—Farming, **A**—Activities & **R**—Resource, **M**—Management (*i.e.*, for resource poor & marginal farmers)
- Good Crop—**'VICTORY'**—(**V**—Variety, **I**—Irrigation, **C**—Control Pests & Disease, **T**—Tillage, **O**—Organic Matter use, **R**—Rotation of Crops follow, **Y**—Yield better.
- **Animal Husbandry**—4 Points (Breeding, Feeding, Heating & Weeding mean disease free)
- **Celebrate after Good Crop harvest/New Year**—**'4 M'** (**M**—Mun/mind, **M**—Mosum (weather), **M**—Manjar (Hills) & **M**—Maya (self-mojmasti)
- **For Agriculture Extension services**—"To serve the farmer is to serve the God."
- Triple R **(RRR)** Scheme for Water Bodies—$R_1$-Repair, $R_2$-Renovation and $R_3$-Restoration.
- KSA for any success—**K**-Knowledge **S**-Skill **A**-Attitude.

### New Schemes in Agriculture Sector

- **'KCC'** (Kisan Call Centre)—w.e.f. 21 Jan., 2004—toll free No. 1800-180-1551 and; 144 Call Centres presently at 14 locations in India functioning to strengthen **'KKMS'** (Kisan Knowledge Management System) through correct answers to farmers queries.
- **'NRAA'** (National Rainfed Area Authority) Scheme—w.e.f. 10 Aug., 2006 & RADP (Rainfed Area Development Programme) Scheme launched in XI Plan & implemented from 2008-09.
- **Rural Knowledge Centres**—by **NABARD** in Rural Areas for transfer of technology on agriculture to farmers—established by GOI.
- National Jute Board (w.e.f. 2006)
- National Tobacco Board (1 June, 1976 est.)
- National fisheries Development Board 2 Aug., 2006—NFDB, HQ-Hyderabad.
- Allahabad Agriculture Institute (AAI)—Deemed University est-in 1910, now changed into Sam Higginbottom Institute of Agriculture, Technology and Sciences (SHIATS)—India's **first** Institute/Univ.–awarding B.Tech Agric. Engineering degree.

●●●

# 13 ANIMAL HUSBANDRY, DAIRYING AND VETERINARY SCIENCE

## (National Animal—Tiger (*Panthera tigris*)

### *General*

- In the World, India's rank is **'first'** in respect of milk production, buffalo population, **second** in cattle and goats, **third** in sheep 5th-Ducks, and chickens/or poultry, 10th in Camel, population, but in egg production, our country is on **'Third'** rank, while U.S.A. ranks **first** in egg production.
- India is the **second** largest in fish/aquaculture production 8·29 million during 2010-11 in world.
- In India, the per capita per day milk availability (in g) was found as—In 1950-51—124, 1960-61—124, 1970-71—112, 1980-81—128, 1990-91—176, 1996-97—202, 2000-01—215, 2001-02—221, 6188, 2003-04—231 and in 2010-11—281 g. (World average 286 g/day/capita). Say, it has reached nearly **'two folds'** within 5 decades. However, the recommended milk availability per capita by the ICMR is 280 g. Thus, India continues to be the largest producer of milk in the world.
- In India, the total milk production was only 17·0 million tonnes in 1950-51, while it was 121·8 million tonnes in 2010-11, as against 84·3 million tonnes in 2001-02. Thus, within nearly 60 years, it has gone to about **7 folds'**. However, it was obtained 20·0 (1960-61), 22·0(1970-71), 31·6 (1980-81), 53·9 (1990-91) and 80·8 million tonnes milk production (2000-01).
- In the country, Cattle-Wealth sectors (during 2010-11) have produced 121·8 million tonnes milk, 63·0 billion eggs (Nos.), 43·0 million kg wool and 8·3 million tonnes total fishes (3·4 mt marine & 4·9 inland).
- The cattle-wealth sectors contribute a lot in the country, by providing regular employment to mainly 19 millions peoples (men) and for 9 million peoples-as subsidiary form.
- In cattle-wealth sectors, the share of women in labour force is nearly 71%, whereas in Agriculture (farming), it is hardly 35%. About 0·5 million women are employed in pre and post–harvest operations in marine sector.
- World's costly female-dog-cost Rs. 7·30 lakh auction in Britain in 2012 year, 18 months age black and white colour.
- The contribution of livestock and fisheries sector (during 2009-10) in GDP–Gross Domestic Products was 4·1%.
- In the World, India ranks **'first'** in buffalo population (57%), II in cattle (14%) and of fisheries as **III** rank and in Fresh Water Fish–as II largest producer country.
- During 2010-11, the total fish production (Marine and Inland both) in the country, it was obtained 8·29 million tonnes. However, the total fish production during 1950-51, it was hardly 0·7 million tonne. Thus, nearly 9 times increase was recorded during last 60 years.
- Under Ministry of Agriculture (Govt. of India), the Department of Animal Husbandry, Dairying & Fisheries (Previously Known as 'Department of Animal Husbandry & Dairying') came into existence on 1 February 1991 and Fisheries was transferred to the Department on 10 Oct. 1997. The website of the Department is 'http : // dadf.gov. in.
- Animal Husbandry output constitutes about 31·7% of the country's agricultural output.
- The livestock & fisheries sectors, contribution is about 4·10% in G.D.P. (2010-11)
- India accounts for 57% of the world's buffalo population and 14% of the cattle population. According to the Livestock Census 2003, the country has about 18·52 crore cattle and 9·79 crore buffaloes, as compared to 15·5 crore cattle and 4·3 crore buffaloes in 1951.
- The present per day availability of animal protein in an Indian diet is 10 g per person, as against a world average of 25 g per capita per day. Thus, it has to increase at least two-folds for proper nutritional level.

- Presently, in India, there are about 50·8 million sheep and 115 million goats, and nearly 5 million households are engaged in rearing for small ruminants (sheep, goats and rabbits) and other allied activities.
- In England, 3 years aged duck was auctioned in year 2012 cost Rs. 1·30 lakh (1500 pounds).
- World's tallest Holstein-Friesian cow, having 6 feet and 4 inches height in Newada (2012).
- 'Milk and Milk Product Order-1992' was notified on June 1992.
- **'Conservation of Threatened Breeds'**—a new centrally-sponsored scheme has been started during 10th Five Year Plan.
- A Centrally-Sponsored Scheme "Assistance to **States** for modernisation/improvement of abottoirs and establishment of carcass utilization centres and primary hide flying units" is being implemented for meat production/ processing and export.
- Nearly 2·44% of total geographical area (329 million hectare) and 11·29% of agriculture use land (142 million hectare) are under the use of animal husbandry.
- Nearly 16·23% of the World-Total Cattle and 47·16% of Asia is in India; and is expected to reach upto 21·8 crore in the country by 21st century.
- India has 4·58% sheep of the World and 9·26% of Asia; that may reach upto 5·51 crore by the end of 21st century.
- NDDB (National Dairy Development Board) Anand (Gujarat) was established in the year 1965 as—I chairman Dr. V. Kurean and DMS—Delhi Milk Scheme in 1959.
- The separation of Animal Husbandry and Dairying Department from Agriculture Ministry, Govt. of India was done on Feb. 1, 1991 and fisheries was transferred on 10 Oct., 1997.
- Technology Mission On Dairy Development Project (in 16 states) was started in 1988.
- Cattle Insurance Plan (Pashu Beema Yojana) was started from 1974.
- **'White Revolution'** and **'Operation Flood'** programmes are related to milk production and Milk Development Projects. The Operation Flood–III stage was completed on 30 April, 1996.
- Milk & Milk Products Order (MMPO)-1992 was notified by the Government of India.
- 'All India Co-ordinated Research Project on Goats' was launched by the ICAR in 1971.
- National Commission on Agriculture (1976) & Govt. of India recommended for at least 10% of cultivable irrigated area should be allocated for quality fodder production.
- Govt. of India has established 3 Feed Analytical Laboratories at (i) Bhubaneshwar (Orissa), (ii) Aarey Milk Colony, Mumbai and (iii) U.T. of Chandigarh.
- Artificial Insemination (AI) Programme was first started in India at the Palace Dairy Farm at Mysore in 1939.
- The first buffalo calf through AI was born in 1943 at the AAI (Allahabad Agricultural Institute) Allahabad (U.P.).
- The successful freezing of bull spermatozoa at (–) 79°C and its freezing capacity was first reported in 1952.
- In India, buffaloes form about 30% of the cattle population and they produce about 52% of total milk yield.
- India possesses 27 acknowledged indigenous breeds of cattle (cows) & 7 breeds of buffaloes.
- 7 Central Cattle Breeding Farms at Suratgarh (Raj.), Chiplima & Semiliguda (Orissa), Dhamrod (Gujarat), Hessarghatta (Karnataka), Alamadi (T.N.) & Andeshnagar (U.P.) are engaged in cattle buffalo breeding programme.
- World Wildlife Day 6 October.
- World Veterinary Day—28 April.
- World Animal Welfare Day—4 October.
- **Major Institutions**—
  - Central Goat Research Institute (CGRI / CIRG), Makhdoom, Farah (Mathura),–U.P.; Central Buffalo Research Institute (CIRB), Hisar (Haryana); Central Aviation Research Institute (CARI), Izatnagar (Bareilly)-(U.P.); Central Food-Technology Research Institute (CFTRI), Mysore (Karnataka); Central Institute for Fisheries Education (CIFE), Mumbai (Maha.) and Central Sheep and Wool Research Institute (CSWRI) Malpura, Avikanagar (Rajasthan).
  - CIFRI (Central Inland Fisheries Research Institute) Barackpore Kolkata–esti. 1947.
  - Central Institute of Fisheries Nautical and Engineering Training, Kochi (Kerala), Central Institute of Coastal Engineering for Fisheries, Bangalore and Fisheries Survey of India, Mumbai.
  - Indian Grassland and Fodder Research Institute (IGFRI), Jhansi (U.P.) and Indian Veterinary Research Institute (IVRI), Izatnagar (Bareilly, U.P.)

— National Dairy Research Institute (NDRI), Karnal (Haryana); National Institute for Animal-Genetics (NIAG), Karnal; National Institute on Nutrition (NIN), Hyderabad and Fisheries Survey of India, Mumbai.
— Project Directorate for Cattle, Meerut (U.P.); Project Directorate for Poultry, Hyderabad (A.P.); Integrated Fisheries Project, Kochi.
— Veterinary Science University, Chennai (T.N.), U.P. Pt. Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwa Vidayalaya Evam Go Anusandhan Sansthan, Mathura (U.P.).
— Central Cattle Breeding Farm (CCBF) at Dhamrod, Surat (Gujarat); Andhesh Nagar, Distt. Lakhimpur (U.P.), Similiguda (Orissa); Suratgarh (Raj.), Chiplima (Orissa), Avadhi, Alamadhi (Chennai), Hessarghatta (Bangalore); Central Frozen Semen Production and Training Institute, Hessarghatta, Bangalore; Central Sheep Breeding Farm, Hisar; Central Poultry Breeding Farm,Hessarghatta,(Bangalore) and Bhubaneshwar (Orissa).
— Central Herd Registration Unit (s) at; Rohtak (Haryana), Ajmer (Raj.), Ahmedabad, Santhapat and Ongole (A.P.).
— Delhi Milk Scheme (DMS) received raw/ fresh milk from-provincial Co-operative Dairy Federation (PCDF) Lucknow; HDDCF (Haryana), Chandigarh; Milk Federation Punjab; RCCDF Ltd. Jaipur; Indore Milk Federation, Ujjain Milk Federation, Gwalior Milk Federation; Kondali Development Co-operative Societies, Delhi; Adarsh Dairy Co-operative Society, Delhi; Rajasthan Sweets and Dairy Products Co-operative Ltd., Bikaner.

- DMS (Delhi Milk Scheme) set-up in 1959 has its present capacity to sale on an average per day of nearly 5 lakh litre milk. (Website : http : lldms.gov.in)
- The Ministry of Food Processing Industries was later transferred to the Department of Animal Husbandry & Dairying w.e.f. Oct. 10, 1997 (from Ministry of Agriculture), which came into existence w.e.f. Feb. 1, 1991 in Agric. Ministry.
- NDDB (National Dairy Development Board), Anand (Gujarat) was set-up in 1987 to accelerate the pace of dairy development on Co-operative lines.
- Indian Veterinary Council Act, 1984; the Department of Animal Husbandry conducted the first Election of Veterinary Council of India in Nov. 1999.
- According to 18th Livestock Census 2007, (Cattle population in million)—Cattle-199·07, Buffalo-105·3, Sheep-71·5, Goat-140·5, Pigs-11·1, (Total Livestock-529·6 million) and Poultry-648·8 million. This has recorded corresponding increased in number, compared over Census 1997 to the tune of – 6·8, 8·9, 6·96, 1·38, 1·51, respectively, *i.e.* – 1·1% cattle, 1·4%, buffalo, 0·26% pigs, 1·13% sheep and 2·3% goats yearly increase was noted, which remained 5·85% in poultry.
- In the year 2007-08, the total milk production in the country was recorded 104·8 million tonnes, which is now 121·8 mt. in 2010-11 on the maximum place in the world. Thus, India has become now a largest milk producer country (Ranking I) at the global scenario.
- The world's first turkey embryo culture chick in laboratory was developed at the CARI, Izatnagar (Bareilly) U.P. This was developed by a simple and efficient double window embryo culture system for production of embryo of turkey chick.
- Citric acid and neem bark powder prevents fungal infestation of stored feeds–a new ITK (Indigenous Technical Know-how).
- Sheep manure improves biological yield of fodder production.
- **Prosopis juliflora** (Subabool) feed replaced barley concentrate in sheep diet satisfactorily.
- The ranking of top feeds is as fellows—

  **Very good—Leucaena leucocephala, M. ozedarach, Zizyphus jujube**

  **Good—Carissa spinarum, Z. nummularia, Hippophoe rhamnoides**

  **Average—Ficus roxburghii, Robinia pseudoocacia**

  **Poor—Quereus incana**
- **Zoological/Scientific Name of—Cow (Bos taurus, B. indica), Buffalo (Babulus bubalis), Sheep (Ovis aries), Goat (Capra hircus), Pig (Sus serofa, S. vittatus,** and **S. domestic) Camel (Camelus bactrianus, C. dromedarius), Horse (Equus cuballus)** and **Ass (Equus asinus)**.

- **Terms Used for Animals**—

| S. No. | Animal | Male | Female | Young | Group | Delivery / Caving |
|---|---|---|---|---|---|---|
| 1. | Cattle (Cow/ Buffalo) | Bull, Ox (Castrated) | Cow | Calf Heifer (female) Bullock/strik (male) | Herd, Drove | Calving |
| 2. | Goat | Billy, Buck | Nanny, Doe | Kid | Flock, Herd, Tribe | Kidding |
| 3. | Sheep | Ram, Tup | Ewe | Lamb, Teg, Hog. | Flock, Trip Herd, Drove | Lambing |
| 4. | Pig | Boar | Sow, Gilt | Piglet, Gilt (female) | Herd, Sounder | Furrowing |
| 5. | Horse | Stallion Horse | Mare Dam | Foal, Colt (Male), Filly (female) | Herd, Team, Stabble, Troop, Rag | |
| 6. | Dog | Dog, Hound | Bitch | Pup, Puppy Whelp | Pack, Kennel, Litter | Whelping |
| 7. | Rabbit | Buck | Doe | Kitten | Kitten | — |
| 8. | Rat | Buck | Doe | Nestling | Colony | — |
| 9. | Fowl (Poultry) | Rooster, Cock | Hen | Chick | Flock | Laying, Hatching |
| 10. | Cat | Tomb | Queen, Tabby | Kitten | Litter | — |
| 11. | Fox | Dog | Vixen | Cub | Shulk | — |

- **Formula for assessing the age of animals (years)**—2 + No. of rings on horns; say, one (first) ring is appeared on horns at the age of 3 years and there after one ring increases every year.
- **Duration of heat period (hrs) in animals;** Cow (12-24), Buffalo (18-36), Sheep (36), Goat (48-72), Pig (2-3 days), Mare (4-7 days), Bitch (7-9 days).
- **Number/times to heat in a year**—Cow and Buffalo (several times); Sheep, Goat, Pig & Mare (several times in season) and Bitch (one time, occasionally twice)
- **Mating period (months) of animals**—Cow, Buffalo, Pig and Mare (all)-through-out the year); Goat-(September-February) and Bitch–(September-October) months.
- **Range of Common body temperature (°F) of healthy animals**—Cow-Buffalo (101-102), Sheep-Goat (101·5-104), Pig (101-103·5), Hen (105-109·5), Horse (99·4-101·2), Camel (97-101), Dog (100-102) and Cat (100-102 °F) *i.e.* **Mean (average) temperature)** (°F) correspondingly as : 101·5, 103·5, 102, 107, 100·5, 100, 101 and 101°F.
- **Respiration rate/minute of healthy animals**—Cow-Buffalo (12-18), Sheep-Goat (14-22), Pig (8-18), Hen (15-28), Mare (8-10), Camel (10-15), Dog (14-30) and Cat (20-30).
- **Pulse rate / minute of healthy animals**—Cow-Buffalo (42-50), Sheep-Goat (67-82), Pig (60-80), Hen (120-160), Horse (36-42), Camel (50-60), Dog (42-80) and Cat (110-230).
- Important breeds of Pigs—White Yorkshier, Workshier, Tamworth, Landres and Hempsier.
- The maximum body weight of pig (boar)—White Yorkshier-(male 300-450 kg, Female-250-350 kg).
- **Improved deshi breeds of sheep**—Bikaneri, Hissardale, Lohi, Bhakarwal, Chokla, Hassan, Bellary, Jaisalmeri, Nellore and Gurej.
- **Exotic Sheep breeds**—Merino, Rambouillet, Polworth.
- **Coarse Carpet Wool Breeds of Sheep**—Malpura, Jalauni, Bellary, Deccani, Chhotanagpuri, Ganjam, Bhakarwal and Shahabadi.
- **Hairy meat breeds of sheep**—Nellore, Hassan, Mecheri, Madras Red and Vembur.
- **Exotic-Fine Wool breeds of Sheep**—Merino, Rambouillet and Polworth.
- **Exotic**—Mutton breeds of Sheep–Suffolk, Dorset and South down.
- **Dual-purpose (both meat & wool productions quality) breeds of Sheep**—Corriedale (imported from Australia).
- **Pelt breeds of Sheep**—Pelt sheep are maintained for their lamb pelt, which are used for garments. *e.g.,* Karakul.
- **Wool and Carpet purpose breeds of Sheep**—Bikaneri, Nali, Marwari, Chokla and Kachhi.
- **Meat purpose breeds of Sheep**—Hastnagari, Deccani and Bhakarwal.
- **For meat, wool and milk (Triple purpose) breeds of Sheep**—Lohi.

- **Wool and meat purpose Indian breeds of Sheep**—Hissardale, Kachhi and Gurej.
- **Domesticated Sheep**—Scientific/zoological Name–**Ovis aries** (Genus-ovis, species-aries), **family-Bovidae.**
- The wild ancestor of sheep in India and Arabia–**Ovis orientale**
- The goat belongs to the family–**Bovidae,** Zoological Name–**Capra hircus** (domesticated goats).
- **Exotic breeds of goat**—Tog-genberg, Saanen, Alpine, Nubian and **Angora** (for mohair-a valuable textile fibre)
- **Himalayan (Hilly tract) region breeds of goat**—Himalayan (breed), **Pashmina** (the hairs of this breed–softest, warmest, high quality fibre/fabrics) and Chegu.
- **Northern region breeds of goat**—Jamunapari, Beetal and Barbari.
- **Central region breeds of goat**—Marwari, Mehsana and Zelwadi, Berari, Kathiawari.
- **Southern region breeds of goat**—Surti, Deccani, Osmanabadi and Malabari (Tellicherry).
- **Eastern region breeds of goat**—Bengal, Assam hilly breed.
- Exotic breed of cow does not have hump and mostly animal-hornless.
- **Average milk composition (%) of milk**—
  **Cow**—Water (86·61), Fat (4·14), Protein (3·58), Total Solids (13·19), SNF–9·25, Lactose–4·96 & Ash (0·71)
  **Buffalo**—Water (82·76), Fat (7·38), Protein (3·60), Total Solids (17·24), SNF (9·86), Lactose (5·48) and Ash (0·78).
- **Fat (%) in Milk**—**Sheep** (8·92 maximum), **Goat** (4·93), **Buffalo** (7·5), **Cow** (4·92), **Extotsic cow** (3·75%), **Human Woman** (3·3), **Camel (5·38), Mare** (1·59) and **Ass** (2·53%).
- **Protein (%) in milk**—**Sheep** (6·25% maximum) and **Cow** (3·21).
- **Lactose (%) in milk**—**Cow** (4·96), **Buffalo** (5·48), **Mare** (6·14), **Ass** (6·07) and **Woman** (6·80%-maximum).
- **Body Temperature of Cattle**—(Conversion factor for temperature)— $\frac{C}{5} = \frac{F-32}{9}$
  Say,
  (i) Change of °C in °F = Multiply by $\frac{9}{5}$ and add (+) 32
  (ii) Change of °F in °C = Deduct 32 and multiply by $\frac{5}{9}$
- **Virus diseases** are—Foot and Mouth, Rinderpest and Cow Pox.
- **Bacterial diseases** are—Anthrax, Black Quarter (B.Q.), Mastitis, Pneumonia, T.B.–Tuberculosis, contagious Abortion, Circiling disease etc.
- **The diseases caused by Protozoa**—Tick-Fever or Spirochaetosis, Surra (Trypanosomiasis), Fever/Pyrexia etc.
- **Average life duration of animals** (in years)—Cow-Ox (18-22), Horse-Mare (25-30), Buffalo (22-25), Sheep (10-12), Goat (10-15), Dog (10-15), Pig (12-15) and Camel (35-40).
- In Cities, generally **Oxytocin** is used as injection by the cattle (cow/buffalo) rearing men, on the death of calves/heifers, this medicine is prepared by the female hormones. This is harmful for human health, if such type of milk is used even by small children and also affect directly for creating eye cancer. With the use of continuous injection, cattle looses its capacity of calving, besides sterility. in place of **Oxytocin**, make a paste of 10-12 seeds of castor (without coat) and use (rub) it on teats before milking for 10-15 days, This would help for regular milk-discharge, without any harm.
- **In deficiency of Vit. 'A'**—Swelling of intestine of animal, nightblindness, weakness of nerves and mucous membranes, born calves having blindness, red eyes remains, stunted growth / or body, born dead/or disable calves etc. are the symptoms.
- **Fat Soluble Vitamins**—Vit. A, D and K; **water soluble Vit.** 'B' group.
- **In deficiency of Vit. 'D'**—Vit. 'D'–is a fat soluble Vit., recognised as an anti-rachitic factor; essential for bone formation, calciferol, (also called anti-ricket Vit.), milk-fever, improper on heat, imperfect calcification of bones and teeth, swelling and weaking of bones are the common symptoms of Vit. 'D' deficiency.
- **In deficiency of Vit. 'C' (Ascorbic Acid)**—Ricket, Teeth and bone diseases occur, do not healing of wounds, reduction in resistanceness of body, etc. are major diseases caused due to deficiency of Vit. 'C'.

- **In deficiency of Vit. 'K'**—Important to poultry, pigs, mice and human being in deficiency-coagulation time of blood increases, danger of haemorrhage (maily due to deficiency of $K_1$ and $K_2$) are the major symptoms.
- **In deficiency of Vit. 'E'**—In deficiency, failure in breeding, does not retain conception, weakness in muscles, sterility, crazy chick disease in poultry (*i.e.* long time eye closing of chick) etc. are major diseases in Vit. 'E' deficiency.
- **Vit. 'B' ($B_1$, $B_2$, $B_3$, $B_6$, $B_{12}$ etc.)**—This group is water soluble; and associated with enzyme systems; and feathers (wings) dropping in poultry, rough skin, paralysis, skin diseases are major symptoms of Vit. 'B' deficiency.

  **Vit $B_1$ (Thiamin)**—In deficiency–beri-beri in man, polyneuritis in birds, calves, loss of appetite, weakness and diarrhoea are common symptoms.

  **Vit. $B_2$ (Riboflavin)**—Curled-toe paralysis and stiff-legs in poultry, cheilosis of skin and eyes of man; loss of hairs in calves, etc. are major deficiency symptoms.

  **Vit. $B_6$ (Pyridoxin)**—Skin lesions; slow growth, loss of appetite are major deficiency symptoms.

  **Biotin**—Dermatitis, loss of hairs, poor growth paralysis of hind quarter in calves are major the deficiency symptoms.
- **Present availability of Protein**—In Indian human diet, presently protein availability is 10 g per person per day as against a world average of 25 g/day/person. It has to increase two folds to maintaining children & nursing mother's in India.
- **'Garima' -World's Second** cloned Buffalo calf-developed through stand guided cloning Technique on 6 June, 2009 by NDRI, Karnal (Hary. ) Scientists Dr. Riyas Ahmedshah.
- **Noori**—Pashmina sheep cloned developed by Dr. Riyas Ahmedshah NDRI Karnal and Dr. Tej Pratap Prof. J and KVV Director Jammu.

## Meaning in one Sentence

- **Bacteria**—A micro-organism-unicelled, that cannot be seen by naked eyes.
- **Disease**—In any organism, an abnormal condition produced by another organism like-parasite, protozoa, fungus, bacteria, virus, nutrients deficiency or by any other cause.
- **Virus**—A kind of tiny (electron / ultramicroscopic seen) living thing, called micro-organism; and causes viral diseases like—foot & mouth.
- **Protozoa**—A microscopic-seen, unicellular living thing/fibre having varying physiology and morphology.
- **Fungus/Fungi**—Low form of plants, made-up of cellular fibres, are considered as fungi.
- **Syndrome**—A group of symptoms in a disease in cattle/plants/human, appears together, showing characteristic of a specified disease.
- **Vaccine**—Virus, bacteria/or rickettsiae *i.e.* solution of dead micro-organism, which is used in treatment of infections disease.
- **Hay (Haylage)**—A grass, feed to cattle, dry after green cut.
- **Artificial Insemination**—Deposition of semen of male animal by artificial means in the cervix or uterus-reproductive organs of female animal (s), at proper time and place.
- **Brood**—In poultry, sitting-on for hatching of children from eggs.
- **Vacca**—Mean cow, Vacca/Vaccination is derived from Latin world.

### Eroding Domestic Animals in India

| Cattle | Buffaloes | Sheep | Goats | Camel | Poultry | Horses |
|---|---|---|---|---|---|---|
| ● Red Sindhi | | ● Nilgiri | ● Chegu | ● Bactrian | ● Aseel | ● Zanskar |
| | ● Nili-Ravi | ● Muzaffarnagari | ● Jamunapari | ● Jaisalmeri | ● Naked Neck | ● Manipuri |
| ● Sahiwal | ● Bhadawari | ● Jaisalmeri | ● Beetal | ● Sindhi | ● Karaknath | |
| ● Tharparkar | ● Toda | ● Tibetan | ● Changthani | | (also all 17 indigenous breeds of poultry) | |
| ● Punganur | | ● Changthangi | ● Surti | | | |
| ● Vechur | | ● Chokla | ● Jakhrana | | | |
| | | ● Malpura | | | | |
| | | ● Bonpala | | | | |

● **India's Share of World**—(i) Biological/Bio-Diversity-2·4% (only), (ii) Rich Animal Diversity-7%, (iii) **Our rich natural breed wealth**—30 breeds-cattle; 10 breeds-Buffaloes, 42% breeds-sheep; 20 breeds-Goats; 9 breeds-camel; 3 breeds pigs and 17-breeds-Poultry.

● India is the home to 57% of world's buffaloes population.

● Father of Biodiversity-E.Q. Wilson.

## *Multiple Choice Questions*

1. **'Operation Flood'** refers to—
   (A) Flood Control
   (B) Control of Soil Erosion
   (C) Milk Production
   (D) Nuclear War Fair Control
2. Match the following—
   **Programme**
   (a) Organization of Dairy and Animal Husbandry Deptt.
   (b) Technology Mission related to Dairy Development
   (c) Cattle Insurance Yojana
   (d) National Dairy Development Board (NDDB), Anand
   **Year of Start / set-up**
   1. 1991 2. 1988
   3. 1974 4. 1987
   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 3 | 2 | 1 |
| (C) | 3 | 4 | 1 | 2 |
| (D) | 2 | 3 | 4 | 1 |

3. The per capita per day milk availability in India was … doing the year 2010-11—
   (A) 170 g (B) 180 g
   (C) 200 g (D) 281 g
4. Mule is the cross of—
   (A) Mare × Ass
   (B) Mare × Horse
   (C) Ass (female) × Ass (male)
   (D) None of these
5. The maximum amount (%) of calcium is found in—
   (A) Milk (B) Butter
   (C) Apple (D) Cheese
6. In India, '18th' Livestock Census was done—
   (A) 1977 (B) 1982
   (C) 1987 (D) 2007
7. Match the following—
   **Name of Cow**
   (a) Holstein – Friesian
   (b) Jersey
   (c) Guernsey
   (d) Brown Swiss
   **Origin Place**
   1. Holland
   2. Jersey Island Group (Britain)
   3. Guernsey Island (France)
   4. Switzerland
   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 1 | 3 | 4 |
| (C) | 3 | 2 | 1 | 4 |
| (D) | 4 | 3 | 1 | 2 |

8. Select correct answer—
   **Programme**
   (a) Central Frozen Semen Production Institute, Hessarghatta (Bangalore)
   (b) Central Institute of Coastal Engineering, Bangalore (Karnataka)
   (c) Marine Products Export Development Corporation
   (d) Central Dairy - Aarey Milk Colony and Milk Product Technology
   **Establishment Year**
   1. 1969 2. 1968
   3. 1972 4. 1956
   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 2 | 3 | 4 | 1 |
| (C) | 3 | 2 | 1 | 4 |
| (D) | 4 | 1 | 2 | 3 |

9. Select correct answer—
   **Cow-breed**
   (a) Sahiwal
   (b) Red Sindhi
   (c) Kosi
   (d) Haryana
   **Origin-Place**
   1. Montogomery (Pakistan)
   2. Sindh (Pakistan)
   3. Alwar, Bharatpur (Rajasthan)
   4. Hisar, Rohtak, Karnal (Haryana)
   **Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 3 | 1 | 2 |
| (C) | 2 | 3 | 1 | 4 |
| (D) | 4 | 1 | 2 | 3 |

10. Select correct answer—

**Institution**

(a) Poultry Training Institute
(b) Bee Keeping Research Institute
(c) Indian Dairy Corporation
(d) Indian Dairy Research Institute

**Place**

1. Bangalore
2. Pune
3. Anand
4. Karnal

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 3 | 1 | 2 | 4 |
| (C) | 2 | 4 | 3 | 1 |
| (D) | 4 | 1 | 2 | 3 |

11. Which group is false ?

| | Name of cattle teeth | Age (in which these teeth come-out) | Age (in which these teeth fall) |
|---|---|---|---|
| (A) | Temporary–Central Incisors | 1-7 days | 10 months |
| (B) | Temporary–Lateral Incisors | 14-21 days | 18 months |
| (C) | Permanent–Middle Incisors | 2·2-3 years | 7 years |
| (D) | Permanent–corner Incisors | 4·5-5 months | 9 months |

12. Match the following—

**Buffalo breed**

(a) Murrah
(b) Jaffarabadi
(c) Bhadawari
(d) Surti

**Keeping Farms, (possessing) pure breeds**

1. IVRI, Izatnagar, Pantnagar, Madhuri Kund Farm
2. Cattle Breeding Farm, Morabi (Gujarat)
3. Cattle Breeding Farm, Bharari (Jhansi)
4. Cattle Breeding Farm, Bakrol, Badodara (Gujarat)

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 2 | 1 | 3 |
| (C) | 2 | 3 | 1 | 4 |
| (D) | 3 | 2 | 1 | 4 |

13. The most suitable method of milking is—
(A) Fisting (Full hand) method
(B) Stripping method
(C) Knuckling method
(D) None of these

14. Egg-Yolk contains the maximum amount of—
(A) Fat
(B) Carbohydrate
(C) Protein
(D) Micro-element

15. How many total bones are present in the body of a horse ?
(A) 150 (B) 175
(C) 205 (D) 225

16. How many total bones (in number) are found in the body of a cow ?
(A) 170 (B) 175
(C) 180 (D) 185

17. The largest cattle fair is held at—
(A) Harihar area Sonpur (Bihar)
(B) Pantnagar (Uttaranchal)
(C) Shikohabad (U.P.)
(D) Parwatsar (Rajasthan)

18. The milk of goat is easy digestible, because—
(A) Due to less protein
(B) Due to smaller fat globules
(C) Due to very less amount of fat
(D) None of these

19. Dr. V. Kurean is related to which field ?
(A) Animal Husbandry
(B) Agriculture Production
(C) Milk Production
(D) Fish Production

20. Flavoured Milk is a—
(A) Pasteurized milk
(B) Sugar and flavour in pasteurized milk
(C) Flavour in pasteurized milk
(D) None of these

21. Match the following—

| Cattle | Maximum Number found in the World |
|---|---|
| (a) Pigs | 1. China |
| (b) Sheep | 2. Australia |
| (c) Goats | 3. India |

**Code :**

| | (a) | (b) | (c) |
|---|---|---|---|
| (A) | 1 | 2 | 3 |
| (B) | 3 | 1 | 2 |
| (C) | 2 | 1 | 3 |
| (D) | 2 | 3 | 1 |

22. Match the following—

| Cattle | Maximum Number in the World |
|---|---|
| (a) Cow and Buffalo | 1. India |
| (b) Hen and Ducks | 2. China |
| (c) Sheep | 3. Australia |

**Code :**

| | (a) | (b) | (c) |
|---|---|---|---|
| (A) | 1 | 2 | 3 |
| (B) | 2 | 1 | 3 |
| (C) | 3 | 2 | 1 |
| (D) | 2 | 3 | 1 |

23. Which is not matched ?

**Nutrient / Element**

(a) Carbohydrate
(b) Protein
(c) Fat
(d) Conversion of milk into curd

**Bacterial Fermentation**

1. Streptococcus lactis
2. Bacillus subtilis
3. Pseudomonas fragi
4. Lacto bacillus thermophilus

**Code :**

(A) All are correct (True)
(B) None is correct (True)
(C) (a) is correct, rests–incorrect
(D) (b) is correct, rests–incorrect

24. Match the following—

**Disease caused by milk**

(a) TB (Tuberculosis)
(b) Typhoid fever
(c) Cholera
(d) Scarlet

**Carrier Bacteria**

1. Mycobacterium tuberculosis
2. Salmonella typhose
3. Vibrio Species
4. Streptococcus scarlatine

**Code :**

| | (a) | (b) | (c) | (d) |
|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 |
| (B) | 4 | 1 | 2 | 3 |
| (C) | 2 | 1 | 3 | 4 |
| (D) | 3 | 2 | 1 | 4 |

25. The cause of **'Pica'** disease/disorder in cattle is (due to)—

(A) Vit. '$B_1$' deficiency
(B) Zinc deficiency
(C) Vit. 'K' deficiency
(D) Phosphorus deficiency

## *Select —True and False*

1. Vit. 'H' (Biotin) is mostly found in cereals, eggs, milk, liver and green vegetables. (…)
2. Vit. 'C' (Ascorbic Acid) is found in abundance in leaves of cabbage, green vegetables, mango, papaya, tomato, citrus, orange, **Aonla** and fresh fruits. (…)
3. The main source of **Vit. D** is sun-light. (…)
4. Barbari, Beetal, Ganjam, Sirohi, Jamunapari and Mahsana are the breeds of goat, found in India. (…)
5. Goat belongs to the family Bovidae. (…)
6. The Southern region goat breeds are Surti, Deccani and Osmanabadi and Malabari. (…)
7. The exotic breeds of goat are Saanen, Alpine, Nubian, Toggenberg and Angora. (…)
8. Angora breed of goat produces most valuable textile fibre, commercially known as **Mohair**. (…)
9. The goat belongs to ruminant animal, having hollow-horned. (…)
10. The goat is known as the **'poor man's cow'** in India. (…)
11. The goat's breed **'Pashmina'** produces softest, warmest animal fibre-a high quality fibrics and valuable downy hairs; known as **'Pashmina'**. (…)
12. The Scientific name of goat is **'Capra hircus'** (domesticated goat). (…)
13. Cow, buffalo, sheep, goat, camel and deer are the ruminant animals. (…)
14. Pig, horse, elephant, dog, cat, rabbit, monkey and zebra are the non-ruminant animals. (…)

15. Generally ruminant animals have four chambered stomach. (…)
16. Non-ruminant animals have **one** (single) chambered stomach. (…)
17. Camel's stomach is **three** chambered. (…)
18. Cow and buffalo are herbivorous animal. (…)
19. Lion is a carnivorous animal. (…)
20. Dog and man are Omnivorous. (…)
21. The newsletter (Quarterly)–Dairy News is published from Karnal and Poultry Guide (Monthly) from, New Delhi. (…)
22. The wool of Marino Sheep is famous for fine wool. (…)
23. In India, the Artificial-Insemination (A.I.) was done for the first time in 1939. (…)
24. In India, for the first time, a successful Artificial Insemination (A.I.) was done by Dr. Sampat Kumaran. (…)
25. The full mouth stage of cow and buffalo is 5 to 5·5 years. (…)
26. The temperature of artificial vagina is kept 42°C. (…)
27. If a bullock has 4 pairs of teeth (permanent), then the age would be 3 years. (…)
28. Bhadawari buffalo has maximum fat percentage in milk, ranging from 7–13%, among all buffalo breeds. (…)
29. The Pulse rate of cattle (cows) is 40–60 per minute. (…)
30. The respiratory rate of buffalo is 12–18 per minute. (…)

## *Fill-up the blanks*

1. Meat, Milk, Egg, Soybean and Fish powder have maximum amount of Vit. ….
2. The meat of goat has … % protein.
3. The **'Key Village Scheme'** was started in first Five Year Plan in the year … for cattle-breeds improvement.
4. The family of cow, buffalo, sheep and goat is ….
5. Karan Swiss, Karan Fries and Jar Sindh are the … breeds of cows.
6. For textile industry, the breeds of sheep-Hisar Dale, Kashmiri Merino, Avivashtra and Nilgiri provide ….
7. The origin place of Merino Sheep is …, that is famous for best quality wool.
8. Bhadarwah breed of …, is famous quality wool, used for **showl** and **Dushale** etc.
9. For **Angora** hair production, the famous exotic breeds of goats are ….
10. The … breed-Pashmina is found in hilly areas of Himalyay.
11. Through hybridization of Tharparkar and Holstein Friesian cows …, breed was obtained.
12. The cow breed … was obtained through the hybridization of Sahiwal and Brown Swiss.
13. ILI–80 is a hybrid breed of …, that is found in India.
14. The standardization of Indian Feed standards was made by 'Sen and Ray' in the year ….
15. Food standards, related to pig-development was prepared by … in the year 1961.
16. Maize, sorghum and oat are … fodders.
17. Lucerne, Berseem, Lobia and **Guar** are … fodders.
18. The total of all carbonic digestible nutrients in any food material is called ….
19. The ratio of DCP (Digestible Crude Protein) and Digestible Nitrogen free Nutrients in any food material is called ….
20. The dry fodder is called …, which is also called 'Hay'.
21. In India, the first time Artificial Insemination Programme (AI) in the year 1939 was initiated at Palace Dairy Farm, … (City).
22. At IVRI, Izatnagar, Artificial Insemination was started in the year ….
23. **'MBRT'**—Methylene Blue Reduction Test is used to test the chemical analysis of ….
24. The length of spermatozoa of a Cow-Bull is in range of … to … micron.
25. The hybridization (cross) on mating between Jack and Mare produces … (hybrid).
26. The cross between stallion and Jannet (on mating) produces ….
27. The cross (hybridization) between 'Male Zebra × Horse' produces … and between Cattle (Cow) × Americy Bison produces ….
28. In cow, the contagious disease is ….
29. The disease 'Foot & Mouth' in animal is caused due to ….
30. The cause of **Pneumonia** disease in animal is **Pneumono cocci**; which is a ….

## ANSWERS

### Multiple Choice Questions

| | | | | |
|---|---|---|---|---|
| 1. (C) | 2. (A) | 3. (D) | 4. (A) | 5. (D) |
| 6. (D) | 7. (A) | 8. (A) | 9. (A) | 10. (A) |
| 11. (D) | 12. (A) | 13. (A) | 14. (A) | 15. (C) |
| 16. (C) | 17. (A) | 18. (B) | 19. (C) | 20. (B) |
| 21. (A) | 22. (A) | 23. (A) | 24. (A) | 25. (D) |

## True / False

1 to 30 — All are correct

## Fill-up the blanks

1. Vit. 'B'
2. 21·4%
3. 1952
4. Bovidae
5. Hybrid
6. Wool
7. Spain
8. Sheep
9. Alpine & Nubian
10. Goat
11. Karan fries
12. Karan Swiss
13. Hen
14. 1959
15. Mahadevan
16. Non-legume
17. Legume
18. TDN (Total Digestible Nutrients)
19. Nutritive Ratio
20. Haylage
21. Mysore
22. 1942
23. Animal Semen
24. 68 to 74
25. Mule
26. Hinni
27. Jebroid, Cattle (respectively)
28. Haemorrhagic septicaemia
29. Virus (Viral)
30. Bacterial

### Facts : Livestock/Dairy & Fisheries Sector in India

- Website of A.H., Dairying & Fisheries Deptt.—http : // dadf·gov. in.
- India ranks **first** in buffaloes (57%), **second** cattle (14%) & in goats, **third** in sheep; **Fifth** in Ducks & poultry / chickens; 10th in camel population in the world.
- India (now) is **3rd** largest producer of fish in the world & **Second** largest producer in aquaculture production and of fresh water fish in the world.
- Fish production during 2010-11 was 82·9 lakh tonnes.
- About 14·49 million people work in livestock sector, presently.
- Women constitutes 71% of the labour force in livestock farming.
- India continues to be the largest producer of milk in the world.
- NDDB at Anand (Gujarat), Board was set-up in 1965 & declared a statutory Body corporate in 1987 & Chairman Dr. V. Kurean (First)—Who died on 9 Sept., 2012, (91 years) Presently Dr. (Mr.) Amrita Patel.
- The 17th Livestock Census in 2003 & 18th-Completed in 2007.
- During 2010-11, the production of milk was 121·8 million tonnes, fish-about 82·94 lakh tonnes, eggs –63,024 million nos, wool–43·0 million kgs and meat 4·8 million tonnes.
- As per Indian Livestock Census (18th Census–2007), The total livestock number was 5,29,698 and total poulty 6,48,830.
- During 2009-10, the contribution of AH, Dairying & Fisheries sectors was 4·1% in total GDP.
- India has 57% of world's buffaloes population and 14% of cattle (Cows)
- Milk availability during (2010-11)-281 g/day/capita in India (World av. 286 g).

### New Development in AH, Dairying & Fisheries Sector

- Animal Quarantine & Certification Service Centre/Stations (4) in India–New Delhi, Chennai, Mumbai & Kolkata.
- National Institute of Animal Health Baghpat (U.P.)—Under National Veterinary Biological Quality Control Centre.
- Central/Regional Disease Diagnostic Laboratories—(i) Disease Investigation Lab., Pune, (ii) Institute of Animal Health & Veterinary Biologicals, Kolkata, (iii) Institute of Animal Health & Biological, Bangalore, (iv) Animal Health Institute, Jalandhar, & (v) Institute of Veterinary Biological, Khanapara, Guwahati.
- 'Goat' is said to be "Gareev Ki Gay" say—"Poormeans' cow"
- National Project on Rinderpest Eradication. Freedom from Rinderpest Disease–w.e.f. 22 May, 2004 (Second Stage) & I stage—1 March, 1998.
- Freedom from Contagious Bovine Pleurropneumonia (CBPP)—On 25 May, 2007 [recognized by World organisation of Animal Health (OIE)]
- Freedom from Avian Influenza in India—18th Aug., 2006, declared.
- 'Goat' is said to be "Gareev Ki Gay" say—"Poor mens' cow".
- In Uttaranchal, on hilly areas, **rabbit** is rearing for Angora wool-Mohari to prepare Woollen sal/cap/ muffar–a successful work done by DRDO (Defence Research & Development Organization) Haldwani (Nainital).

### Statement—About India (by Mark Twain)

"India is the cradle of the human race, the birth place of human speech, the mother of history, the grandmother of legend and the great grandmother of tradition. Our most valuable and most instructive materials in the history of man are treasured-up in India only." In fact, India is the home to 57% of world Buffaloes population.

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# 14 ENVIRONMENT, POLLUTION & FORESTS

- **National Bird**—Indian Peacock (***Pavo cristatus***)
- **National Tree**—Banyan Tree (***Ficus benghalensis***)

**Slogan—**
Plant Trees, Save Earth

## *General*

- Various Environmental and Forestry Programmes are related to the Ministry of Environment and Forests **(GOI)**-a nodal agency for planning, promotion, co-ordination and over-seeing.
- Forest Survey of India (FSI)-established in 1981, is entrusted with task of surveying the forest resources of the country.
- The Ministry of Environment and Forests also acts as the nodal agency for **'UNEP'** (United Nations Environment Programmes), Integrated Hill Development–related International Centre.
- **Various Programmes Related to Environment & Forests**—Survey of Natural Resources, Bio-sphere Reserves, Wetlands, Mangroves and Coral Reefs, Bio-diversity, Medicinal Plants, Forests-Forest Policy & Law; Integrated Forest Protection Scheme, Wildlife, Environment Impact Assessment, Prevention and Control of Pollution, Management of Hazardous substances, National River Conservation-Ganga Action Plan, Gomti Action Plan; National Lake Conservation Plan (NLCP)–Powai in Maharashtra, Ooty and Kodaikanal in Tamil Nadu (3 lakes), National Afforestation and Eco-Development Board (NAEB), Research Promotion; Forestry Reserach, Wildlife Research, Environmental Information System (ENVIS) and International Co-operation.
- **Climate**—A Latin word was used first in 17th century.
- **Related Fellowships & Prizes (Awards)**

  **'Indira Gandhi Paryavaran Puraskar' (IGPP)**—Awarded every year to organization and individual-worth Rs. 5 lakh, a silver trophy and citation.

  **'Indira Priyadarshini Vrikshmitra Award' (IPVM)**—Constituted by the Environment & Forest Ministry in 1986 for out-standing contribution of Individual & Organization in afforestation and wasteland development fields, annually.

  **Paryavaran Evam Van Mantralaya Vishist Vaigyanik Puraskar (PEVMVVP)**—Instituted in 1992-93 for original and applied research among Group 'A' scientists; every year two awards worth Rs. 20 thousand each.

  **Pitambar Pant National Environment Fellowship Award (PPNEFA)**—Instituted in 1978, awarded annually to excellence in research related to Environmental science.

  **B.P. Pal National Environment Fellowship Award (BPPNEF)**—For bio-diversity in research & development through R & D.

  **Rajiv Gandhi National Wildlife Conservation Award and Dr. Salim Ali & Kailash Sankhala Fellowships**—For eminent officers and field workers for exemplary work in wildlife conservation and research.

  **'Amritadevi Wildlife Protection Award' (AWPA)**—In the name of Amritadevi Bishnoi-to village communities for showing courage & valour for protection of wildlife.

  **Janaki Ammal National Award**—In Taxonomy, worth Rs. 50 thousand and a citation.
- For the year 1999, Dr. B. P. Pal National Environmental Fellowship Award to Dr. K.P.S. Chandel (VPGR); and Indira Priyadarshini Vrikshamitra Award to Prof. R. Raghvendra Rao (NBRI, Lucknow)
- The Forest Administration in India was started in 19th century and which became the subject of the centre in 1921.
- The objective of Forest Management in early, was for reproduction of some useful species like-**Sal (Shoria robusta)**, **Devdar, Sagon (Tetone grandis)** etc.

| ● Acts/Amendments/Society Establishment Year | Society/Acts/Amendments |
|---|---|
| 1890 | The Botanical Survey of India (BSI) established |
| 1916 | The Zoological Survey of India (ZSI) established, H.Q. at Kolkata |
| 1927 | The Indian Forest Act |
| 1938 | The Motor Vehicle Act (re-emendment in 1988) |
| 1972 | The Wildlife (Protection ) Act |
| 1973 | The Tiger Project launched (1 April, 1973) |
| 1974 | The Water (Prevention and Control of Pollution) Act |
| 1977 | The Water (Prevention and Control of Pollution) Cess Act |
| 1978 | The Programme of Environment Impact Assessment (FIA) introduced |
| 1980 | The Forest (Conservation) Act |
| 1981 | The Air (Pollution, Prevention and Control of Pollution) Act |
| 1985 | National Wasteland Development Board-Establishment |
| 1986 | The Environment (Protection) Act |
| 1987 | The Air (Prevention and Environmental Control Amendment Act) |
| 1988 | National Forest Policy (re-revised in 1988, revised in 1952 and formed in 1894) |
| 1991 | The Public Liability Insurance Act (amended in 1992) |
| 1992 | Policy Statement on Abatement of Pollution |
| 1992 | A National Conservation Strategy and Policy Statement on Environment and Development. |
| 1995 | The National Environment Tribunal Act |
| 1997 | The National Environment Appellate Authority Act |
| 2002 | Genetic Engineering Approval Committee (GEAC) of India |
| 2006 | National Environment Policy |
| ● **Institutes/Projects/Rules** | |
| 1960 | The Prevention of Cruelty to Animals Act; new set of rules, namely; Animal Birth Control (Dog) Rules, 2001 and notified on Dec. 2002. |
| 1978 | The National Museum of Natural History (NMNH), New Delhi set-up |
| 1982 | An Environmental Information System **(ENVIS)** set-up |
| 1983 | The first National Wildlife Action Plan (NWAP) framed; and after revision, the new Wildlife Action Plan (2002-2016) adopted. |
| 1985 | The Ganga Action Plan (**GAP** Phase I) initiated and closed on 31 March, 2000 and later on the Ganga Action Plan (**GAP** Phase II) merged with National Reserves Conservation Plan (NRCP). |
| 1988 | G.B. Pant Institute of Himalayan Environment and Development estbd–Aug. 1988, Almora (Uttaranchal) |
| 1992 | The National Afforestation and Eco-Development Board (NAEB) set-up (in August 1992) |
| 2000 | Cartagena Biosafety Protocol—the first International regulatory framework was adopted in India on 29th January, 2002 |

- The forest management means; adoption on scientific, economic and social principles in the working system and administration of any forest-wealth for specific objectives or targets, *i.e.*, The Forest Mangement is the branch of forestry, wherein all related aspects of forests such as; administration, economic, law and social aspects are taken into consideration, and essentially for forest-repropagation by scientific and technical aspects, besides forest conservation and regulations too.
- **Every year celebrated- 'World Forestry Day-March 21', 'World Environment Day-June 5'**
- (i) **In Sandy Soil**—Eucalyptus hybrid, Deshi Babool or Keeker **(Acacia nilotica var, indica),** Hill Babool or Keeker (**Acacia nilotica var.** Cupressiformis), Israili Keeker or Babool (**Acacia leucocephala**), Jund (or Khejri (**Prosopis cineria**), Jorter (**Casuarina equisetifolia**), Shesham (**Dalbergia sissoo**), Siras (**Albizia lebbek**), Ber (**Ziziphus mauritiana**), Neem (**Azadirachta indica**) and Dhrek (**Melia azedarach**)
  (ii) **In water-logged (submerged) soils**—**Arjun** (**Terminalia arjuna/superba**), **Kadam (Anthocephalus sicensia), Willos** (**Calyx sps**) and **Jamun** (**Syzygium cumini**).

(iii) **In Saline and Sodic Soils**—Arjun, Keeker (Babool), Neem, Eucalyptus.

- **'FOREST'**—It gives us/Stands for; F-Food, O-Oxygen, R-Rain, E-Environmental Protections Ecological Balance, S-Soil Conservation and T-Timber.
- **'Man of the Forest'—'Orangutan'**—Primitive of man.
- **National Tree**—Banyan Tree (*Ficus benghalensis*)
- **Sequoia**—Largest plant (115·56 m height) in world, V/s Eucalyptus (99·6 m height).
- **Agro-forestry**—It gives us 6 F *i.e.*, $\mathbf{F_1}$–Food, $\mathbf{F_2}$–Feed, $\mathbf{F_3}$–Fibre, $\mathbf{F_4}$–Fuel, $\mathbf{F_5}$–Furniture Timber & $\mathbf{F_6}$–Funds. The art of growing crops with forestry (both together)
- **Social Forestry**—It is a method of forestry, which is meant for social and done by society, so as to meet-out the need of fuel, fodder, fruit and small timber wood. This helps to make economic and effective use of wastelands.
- Social Forestry has several advantages like-making Ecological balance, provides employment opportunities to poor rural-mass, providing fodder for cattle, provides raw material to cottage industries, silk-worm and cattle, collection and purifying of gum, developing bee-keeping, provides fuel wood for longer period, provides cow-dung (dung), improvement in productivity, stability and making sustainable and bringing unbiasedness in agro-eco-system.
- According to National Forest Policy (1894) and later on revised time to time as latest in 1988), there must be forests on 33% of the country's area.
- India's population as on 1 March, 2001 (census 2001) growing @ 1·94% annual and stood at 1,027 million and accounts for a meagre 2·4% of the world surface and also supports to 16·7% of the world population. By the year 2040, India would stand first in the world in respect of human population.
- According to the world report (1996), in India every year more than 40,000 people will be affected for casual death by air-pollution and Delhi would be the 4th polluted city in the world.
- Of the total air pollution, nearly 70% smoke is generated/excreted from vehicles alone. According to the survey (1989) of the Central Pollution Control Board, in Delhi nearly 872 tonnes particulate, $SO_2$, Oxide of nitrogen, Carbon and hydro-carbon are excreted.
- **Smog** (Smog = **Smoke + Fog**) is very harmful to human; and it can be assessed easily that in 1952, due to **'London Smog'**, the city remained covered by a smog sheet of grey colour for 5 days and left the bad effects, resulting the death of nearly 4000 people and several peoples remained affected by bronchitis and heart disease.
- In city areas, the cause of environmental pollution is the suspended particulate matter. During winter, in air, the level of particulate matter-dust and carbon coated poisonous gases is more than 12 times of the standard level.
- The **'Acid Rains'** is the another component of air pollution. The acid fumes of $SO_2$ excreted by Industries and Nitrogen Oxides combine with water and ice, resulting thereby the acid rains. Therefore, the pH of first rain after summer is always lesser than the subsequent rains.
- The excretion of $CO_2$ is gradually / continuously increasing in atmosphere. Its amount is increased 30% extra in last two centuries. In the world, the maximum excretion is from $CO_2$ (0·2% per capita); in which India ranked on 6th place. The main source of this poisonous gas is the burning of fossil fuel.
- The main sources of water pollution are; the excreted dung, solid, refuse, particles and other dangerous polluted elements, seewege water and sludge of cities in rivers; sharing 30% of water pollution share.

  In the water, the amount of poisonous substances like; cyanide and chromium is nearly 20-22 times increased over safe level.
- According to the report of **'World Health Organization (WHO)'**, in India nearly 21% contagious diseases are caused by the use of polluted water. As per the **'Human Development Report'** (1995) of **'UNDP'**, during the period 1988-93, in India, for nearly 18·57 crore people, the pure drinking water was not available.
- Out of the total Flora & Fauna say; Bio-diversity of the world, nearly 7% part is in India.
- India is one of the 12 mega-bio-diversity countries of the world.
- Out of 18 major centres of bio-diversity in the world, India has two centres say, Western Ghats and East Himalayas.

- About 22% (770·1 lac hectare) of the geographical area of India is covered under forest.
- About-10 years or so (time), are required to become a full tree of **Hill Peepal** (Popululas sps), **Poplar**-5-6 years and **Devdar** (**Cendrus diodara**)–nearly 200 years.
- In the benefits of forest products are; timber wood, bark, fuel, medicines, flower, fruit, gum, for the human needs, and also shelter to the wild animals, etc.
- The concepts under forest management and essentials are; forest management should be mobile (dynamic) and be modified according to the situation.
- The fundamental conditions in forest management are; Two methods of yield expression *viz.*, (i) The flow of forest products expresses in quantity or in price; (ii) The amount/or quantity/price of forest products in any unit be measured in a specific period.
- On 5 June, 1972 in Sweden at Stockholm, the **'World Convention'** of 12 United States on **'Human Environment'** was organised, wherein the megnacart was awarded to environment and much more discussion was made especially; on environment.
- Our surrounding natural environment, in which we and other bio-lives is called environment, say in other words, a group of all external factors influences on any biotic element.
- Bio-sphere means the total space, where life is found in any form. Three large systems of bio-sphere–*viz.*, Hydrosphere, atmosphere and Lythosphere.
- In India, the word **'Ecology'** came into existance in 1960 and so.
- The Wild Animal Protection Council was set-up in 1952.
- World Nature Day—3 October.
- World Standards Day—14 October.
- World Food Day—16 October.
- International Bio-diversity Day—22 May.
- World Pollution Prevention Day—2 Dec.
- In India, the State-level Ecological Council was constituted for the first time in 1970.
- In private sector, for the first time, scientific Institution **Bad Kaner Ecological Foundation** in 1971 was set-up.
- In 1972, National Environment Planning and Co-ordinated Commission was constituted, and also the Advisory Committee was set-up.
- **'NEERI'**—National Environmental Engineering Research Institute, Nagpur (Maharashtra) is an apex Institute for Environmental matters and on the report of this Institute, the decision was taken to keep away Kilns (bricks-Kilns) around 25 km from **'Taj Mahal'** at Agra for controlling the pollution and it is effective.
- On 21 January, 1980, for the first time, the presidential lecture on **'Environment Protection'** was delivered in both the houses of parliament, when Digvijai Singh was the then Environment Deputy Minister.
- The **Chipko** movement (U.P. and now in Uttaranchal) was started in 1973 from Gopeshwar, headed by Sunderlal Bahuguna.
- Central Himalayan Environmental Institute, Nainital (1980) and **'SHERPA'**–Society for Himalayan Environmental Rehabilitation and Peoples Action Institute (1984) were established.
- Pahar Institute Nainital–Poeples Association for Himalyan Areas Research was established in 1982 by the social workers, teachers and students in the leadership of Dr. Shekhar Pathak, from where **'Pahar'** Magazine is published.
- **'INSONA'**–Indian Society for Naturalist at Vadodara, Gujarat in 1975; **'SOCLEAN'**–Society for Clean Environment, Maharashtra; **'APICO'** Movement Karnataka; Indian Environment Association, Delhi-1980 and Uttarakhand Research Institute (1985) were established.
- The amount of $CO_2$ has increased 0·14% in last 100 years in atmosphere due to air pollution.
- There is a scientific concept that the gases are formed from the residues of nitrogen, if their amount in air has increased from 5 ppm (part per million or part per 10 lakh part) to 25 ppm, then that becomes harmful; for example, the created harmful gases at war period; the heaps of wastes in middle of village (s), and waste-residues of nitrogen in excreta in pits or heaps in villages.
- The unhealthy lungs, asthema, TB disease etc., are created by polluted air.
- According to the scientists of 'National Environmental and Engineering Research Institute' **(NEERI)** Nagpur, nearly 75% part of the available water is polluted in the country.

- On 18 July, 1983 in Mumbai, the Acid Rains occur, and hence, on account of this, that day was considered the blackest day in the history of pollution in India.
- With the continuous and heavy use of agricultural chemicals like; Ammonium Sulphate, a huge amount of $SO_2$ is accumulated in agricultural fields; and that $SO_2$ gas forms Sulphuric Acid combining with particles presented in atmosphere, and that affects plants adversely and even soils become acidic in nature.
- In **'Jhum' Cultivation (or 'Jhuming')**, the atmosphere spoils due to de-forestation and residue fire and this type of cultivation is being practised in North-Eastern Region / States (Assam, Mizoram, Arunachal Pradesh, Meghalaya, Tripura) and in some tribal areas.
- The poisonous air component **(Smoke)** makes **'Smog'**, when combines with **'Fog'** and that is more harmful to crops and trees, because the stomata remains close due to dust particles (smokes), consequently photo-synthesis checks and finally the plants die.
- Insecticide Act 1968; Insecticide (Ammended) Act 1972 was passed by the Govt. of India to control chemical pollution.
- The Website of Ministry of Environment & forests (Govt. of India)—http : // envfor·nic·n.
- **'Nature does nothing uselessly'**—Aristotle, 384-322 B.C.
- **'Nature does nothing uselessly'**—Aristotle, 384-322 B.C.
- The standing 5-6 Elephants in group in forest say **"We are to stay here"** meaning thereby do'nt quarrel among themselves.
- **About Nonmenclature in Agriculture** :
  - * **Himachal Pradesh**—The people of H.P. put themselves the name Himachal Pradesh. The **Home Name—'Achala'** (in Sanskrit) meaning a mountain.
  - * **Nepier grass** (Elephant grass)—It termed on the name of colonel Nepier.
  - * **Cereal crops**—Means grain crops like-wheat, rice etc. In Italy (near **Roma** city), there is **'Cereale Goddess'** temple (*i.e.*, **Grain** Giver Goddes).
  - * **Cereale** where fair is held every year and this is celebrated on ripening of wheat crop there.
  - * **Punjab** is said to be the—
    Food Basket of India—
    Grain Storage of India; because, 40-50% rice and 50-70% wheat are produced in the state.

| Facts & Acts related to Environment & Forest | |
|---|---|
| ● The Prevention of Cruelty to Animal Act, 1960 (59 of 1960) | ● The Public Liability Insurance Act, 1991 (6 of 1991) |
| ● The National Environment Tribunal Act, 1995 (27 of 1995) | ● The Indian Forest Act, 1927 (16 of 1927) |
| ● The Wildlife (Protection) Act, 1972 (53 of 1972) | ● The Water (Prevention and Control of Pollution) Cess Act, 1977 (36 of 1977) |
| ● The Forest (Conservation) Act, 1980 (69 of 1980) | ● The Air Prevention & Control of Pollution) Act, 1981 (14 of 1981) |
| ● The Environment (Protection) Act, 1986 (29 of 1986) | ● The Water Prevention & Control of Pollution Act, 1974 (6 of 1974) |
| ● The National Environment Appellate Authority Act, 1997 (22 of 1997) | ● The actual forest area ($km^2$) in India is as (in descending order)–M.P. 76,013 (I rank), Chhatisgarh–55,863 (II), Maharashtra–47476 (III); and U.P.–14127 $km^2$; and Total India–6,77,088 $km^2$. |
| ● National Forest Policy, 1988 | **Note**—(For better climate, atleast–33% area should be under forest in India, which is presently 21·81% of geographical area.) |
| ● Natural conservation strategy & Policy statement on Environment & Development, 1992 | ● Now, it has reduced to 1/3 area of forest, compared to 10,000 years ago. |
| ● Policy statement on Abatement of Pollution, 1992 | ● Water Resource Potential in India–2009 |
| ● National Environmental Policy, 2006 | ● Av. Annual Water Availability—1869 BCM (Billion Cubic Meter) |
| ● Botanical Survey of India (BSI)–Established 13 Feb., 1890 | ● Of which; **Total usable water Resources—1123 BCM;** |
| ● Surface Water—690 BCM and Ground water—433 BCM. | ● Surface water 690 BCM and ground water—433 BCM. |
| Drought Years (For **(HACCP)** in India—1877, 1965, 1972, 1979, 1987, 2002 and 2009. | |

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# 15 MISCELLANEOUS AGRICULTURE & FORMULAE USED IN AGRICULTURE

## *General*

### ● Stages of Agricultural Development in India

India has passed through 4 stages in development of agriculture *e.g.*,

| | |
|---|---|
| 1. | **Pre-Green Revolution** —Boost in productivity growth of coarse grains and pulses per unit of land |
| 2. | **Green Revolution** —Expansion of area and rapid growth in productivity of wheat and rice, improved & HYV's, expansion of agricultural research and irrigation investment. |
| 3. | **Post-Green Revolution** —Continued growth in productivity through intensification of chemicals and labour inputs, followed by a deceleration in productivity growth, Expansion of area under maize, cotton, sugarcane and oilseeds. |
| 4. | **Commercialization** —Further diversification of cropping pattern from low to high value crops such as; fruits, vegetables, flowers and other horticultural crops for domestic consumption, processing and export. |

### ● Major Branches related to Agriculture / Animal Husbandry / Agroforestry

* Agriculture—Agriculture Science (culture of all the cultures/or culture of the times)
* Agronomy—Crop production
* Horticulture—Orchard/Garden Science
* Floriculture—Flower Science
* Pomology—Fruit Science
* Olericulture—Vegetable Science
* Moriculture—In Silk Industry, growing mulberry (Shahtoot) for rearing (on leaves) of silk-worm.
* Sericulture—Silk Industry
* Arboriculture—Study of trees and shrubs
* Aquaculture—Growing plants in water
* Arbori-culture—Cultivation of wood-plants
* Orthinology—Study of birds-nature, songs & flights
* Olviculture—Cultivation of **Jetoon**
* Viticulture—Cultivation of grapes / increasing size of grapes
* Viriculture—Making wine from grape
* Apiculture—Bee keeping
* Citriculture—Cultivation of citrus group
* Pisiculture—Fish-husbandry (Fisheries)
* Glaciology—Study (Science) of changes of ice and all shapes
* Vermi-culture—Earthworm rearing
* Jhuming / Shifting Cultivation—Cultivation by Tribes in Tribal areas in shifting the area
* Agri-Silvi Culture—Growing tree (forest) crops along with agricultural crops (*i.e.*, Tree crops + Agril. crops)
* Agrostology—Study of Grasses
* Auteocology—Study of Environmental Ecology of individual Species
* Bio-technology—Science dealing with the use of micro-organisms / organism to mankind.

### ● Number of Chromosomes in Different Crops—(2*n* numbers)

Rice (**Oryza sativa**) ($n$ = 12); Maize (**Zea mays**) ($n$ = 10); wheat (**Triticum aestivum**)

($n$ = 7); Sorghum (**Sorghum bicolour**) ($n$ = 20); Pigeonpea (**Cajanus cajan**)($n$ = 11); Moth bean (**Phaseolus aconitifolius**) ($n$ = 11); Urd (**Phaseolus or vigna mungo**) ($n$ = 11, 12); Moong (**Vigna radiata**) ($n$ = 11, 12); Pea (**Pisum sativum**) ($n$ = 7); Lobia (**Vigna unguiculata**) ($n$ =11).

- **Miscellaneous – Act**
  - * Uttar Pradesh Panchayati Raj Act–1947 (on 7 Dec) - in force
  - * Uttar Pradesh Panchayat Law Ammended Act–22 April, 1994
  - * Uttar Pradesh Area Committee & District Council (Board) Act, 1961
  - * Balwant Rai Mehta Committee (1957), Ashok Mehta Committee (1978), Laxmimal Sindhvi Committee (1986)–all have accepted the development programmes of Panchayati Raj Institutions / Bodies.
  - * Gram (Village) Panchayats were constituted–Bihar & U.P. in 1947; Tamil Nadu – 1950; Haryana, Himachal Pradesh and Punjab–1952; and Rajasthan in 1953. In these states, separate Act and Laws were made.
  - * **'Community Development Programme'** (CDP) was started on Oct 2, 1952.
  - * National Extension Services were started on the recommendation of **'Grow More Food'** Enquiry Committee in 1953.
  - * Panchayati-Raj Management / arrangement is devided into 3 steps : Ist – from 1959 to 1966; II – 1967 to 1976 and III – 1977 to till date.
  - * In U.P., the first general election of Panchayats was done in 1949; that Panchayats worked up to 1954-55 and in 1955, the second general election was made.

## Some Important Formulae used in Agriculture

- **Crop Rotation Intensity (%)**—

$$= \frac{\text{Number of crops taken / grown in crop rotation}}{\text{Duration of crop rotation}} \times 100$$

- **Cropping Intensity (%)**—

$$= \frac{\text{Total Cropped Area}}{\text{Net Cultivated Area}} \times 100$$

- **Soil Density**— $= \frac{\text{Soil mass}}{\text{Soil volume}}$
- **Specific Gravity of Soil**—

$$= \frac{\text{Mass of total volume of soil}}{\text{Mass of same volume of soil water}}$$

- **Particle density of Soil**—

$$= \frac{\text{Weight of soil solids}}{\text{Volume of soil solids}}$$

- **Apparent or Bulk Density**—

$$= \frac{\text{Soil weight}}{\text{Soil volume}}$$

- **Soil Pore space**—

$$\text{\% Solid Space} = \frac{\text{Bulk density}}{\text{Particle density}} \times 100$$

Since, % Pore space + % Soil (solid) space = 100

and % Pore space = 100 – % Solid space,

then; % Pore space

$$= 100 - \frac{\text{Bulk density}}{\text{Particle density}} \times 100$$

- **Absolute Humidity**—

$$= \frac{\text{Weight of Water Vapour}}{\text{Volume of Air}}$$

- **Relative Humidity (%)**—

$$= \frac{\text{Saturated vapour pressure on dew point}}{\text{Saturated vapour pressure on fixed temperature}} \times 100$$

- **Crop Yield Index** —When both yield and spread indices in any area are maximum, then;

**Yield Index of a crop**

$$= \frac{\text{Average Yield of State / Area (region)}}{\text{Average Yield of Country}} \times 100$$

**Spread Index of a Crop**

$$= \frac{\text{Area in State / Region}}{\text{Area in Country}} \times 100$$

- **Land Equivalent Ratio (LER)**—It's importance lies in intercropping systems.

LER

$$= \frac{\text{Yield of base crop in intercrop system}}{\text{Yield of base crop in sole system}} + \frac{\text{Yield of intercrop in intercrop system}}{\text{Yield of intercrop in sole system}}$$

**Note :**

1. If the LER value is less than 1, then, there is a mutual inhibition between main / base crop and intercrop and hence disadvantage.
2. If LER is equal to 1, then, there is mutual co-operation between two-main & intercrop No advantage).
3. If, LER is more than 1, then, there is compensation between two (main and intercrop). *i.e.*, advantage.
4. **The standard LER value is 1·4**; To show the profitability of any intercropping system, this value should exceed to 1·4 (say above 1·4); otherwise that intercrop system is not profitable.
5. **'LER'** can also be termed as **'RYT'** (Relative yield total). If, **'LER'** is compared on uniform over all plant density of sole / base crop and intercrop, then, that will be called as **'RYT'**.

- **Relative crowding coefficient (k)**—It is a measure of the relative dominance of one crop component crop over the other in an intercropping system. The coefficient (K) is determined separately for each component crop *e.g.*, for crop '*a*' in association with '*b*', the coefficient is as under—

  $$Kab = (Yab \times (Zba)/(Yaa - Yab) \times Zab$$

  where, $Yab$ is the yield of species '*a*' in association with '*b*' $Yaa$ is pure stand yield of species '*a*', $Zab$ and $Zba$ represent the sown proportion of '*a*' (in association with *b*) and of '*b*' (in association with *a*), respectively.

  The component crop with higher coefficient is the dominant one. The product of the two coefficients designated as K, denotes yield advantage if K < 1, no advantage if K = 1 and disadvantage if K > 1.

- **Relative Net Return (RNR)**—It is the ratio between the monetary value of base and intercrop plus differential cost of cultivation (intercropping-monoculture of base crop) and monetary value of base crop in monoculture.

- **Crop equivalent yield**—It is the conversion of crop yields into one form to compare the crops grown mixed/inter-cropped/sequentially cropped.

  Crop Equivalent Yield (CEY)

  $$= \frac{\text{Yield of intercrop (kg)} \times \text{Price of intercrop} \times \text{(Rs./kg)}}{\text{Price of main crop (Rs./kg)}}$$

- **Area Time Equivalency Ratio (ATER)**—It is the ratio of number of hectare-days required in monoculture to the number of hectare-days used in intercropping to produce identical quantities of each of the component crop.

- **Aggressivity**—It gives a simple measure of how much the relative yield increase in species '*a*' is greater than that for species '*b*' in an intercropping system and can be expressed as A*ab*.

  $$Aab = (Yab/YaaZab) - (Yba/YbbZba)$$

  where, $Yaa$—Pure stand yield of species '*a*'

  $Ybb$—Pure stand yield of species '*b*'

  $Yab$—Mixture yield of species '*a*' in combination with '*b*'.

  $Yba$—Mixture yield of species '*b*' in combination with '*a*'.

  $Zab$—Sown proportion of species '*a*' in mixture with '*b*'

  $Zba$—Sown proportion of species '*b*' in mixture with '*a*'.

  If $Aab = 0$, both species are equally competitive; $Aab$ = +ve, '*a*' is dominant species; $Aab$ = –ve, '*b*' is dominated species.

- **Water Use Efficiency (WUE) and Water Requirement (WR)**—

  Water Requirement (WR) is the reciprocal of Water Use Efficiency.

  Thus,

  (i) $WUE = \frac{\text{Dry Matter Production (DM)}}{\text{Evapo-Transpiration (ET)}}$

  (ii) WR = CU + Al + WNSP

  where, WR = Water Requirement, CU = Consumptive Use of water, Al = Application losses; WNSP = Water Needed for Special Purpose, excluding CU + Al.

  or, $WR = \frac{\text{Evapo-Transpiration (ET)}}{\text{Dry Matter Production}}$

  It is usually expressed in weight of equal magnitude as g of water per g of dry matter.

- **Irrigation Requirement (IR)**—
  IR = ER + GWC, where,
  IR = Irrigation Requirement;
  ER = Effective Rainfall
  GWC = Ground Water Contribution
- **Leaching Requirement (LR)**—

$$LR = \frac{Ddw}{Diw} \times 100, = \frac{EC\ iw}{EC\ dw}$$

where, D = depth of water, EC = Electrical Conductivity, dw = drainage water and iw = irrigation water

- **Exchangeable Sodium Percentage (ESP)**—

$$ESP = \frac{\text{Exchangeable Na (m.e./100 g soil)}}{\text{Cation Exchange Capacity (m.e./100 g soil)}}$$

Expressing in percentage, the 'o' degree of saturation of soil exchange complex with sodium

- **Sodium Absorption Ratio (SAR)**—

$$SAR = \frac{[Na^+]}{\sqrt{Y_2([ca^{2+}] + [Mg^{2+}])}}$$

- **Harvest Index (HI)**—
  It is also known as Sink Coefficient, expressed in %.

$$HI = \frac{\text{Economic Yield (or Grain Yield) of crop (q/ha)}}{\text{Biomass Yield (q/ha) (excluding roots)}} \times 100$$

- **Standard Deviation (SD)**—

$$SD = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N-1}}$$

If, in frequency distribution, then,

$$SD = \sqrt{\frac{\Sigma f(X-\bar{X})^2}{N-1}}$$

- **Standard Error (SE)**—

$$SE = \frac{\sigma}{\sqrt{N}}$$

where, σ = Standard deviation

- **Coefficient of Variation (C.V. %)**—

$$C.V.(\%) = \frac{\sqrt{\text{MSS of Error}}}{\text{General Mean}} \times 100$$

Or $= \frac{SD}{X} \times 100$

- **Correction Factor (CF)**—

$$CF = \frac{(\Sigma X)^2}{N}$$

- **Degree of Freedom (d.f.)**—

$$df = N - K$$

where, N = Number of frequency
K = Number of constraints

- **Standard Error of Mean ($SE_m\pm$)**—

$$SE_m \pm = \frac{SD\ (\sigma)}{\sqrt{N}}; \text{ or } \sqrt{\frac{SD^2}{N}}$$

Where, SD (σ) = Standard Deviation
N = Number of Observations

- **Drainage Frequency**—
  Drainage Frequency

$$= \frac{\text{(Total number of outlets)}}{\text{(Area of basin or grid)}}$$

- **Chi-square ($\chi^2$) Distribution**—

$$\chi^2 = \Sigma\left(\frac{fo - fe}{fe}\right)$$

where, Σ = Total of ratios,
fo = observed frequency,
fe = expected frequency

**Note**—Chi (χ) –a Greek word, knowledge given by Away (1863), Helmert (1875) and later on in 1900 Karl Pearson searched this Chi. :

- **pH**—(power of hydrogen ion)—It is related to hydrogen ion capacity. It is the anti-log of hydrogen ion concentration of a solution (of any soil). Soil pH is indicated as;

(i) **Soil** → pH-7 means–neutral;

(ii) **Acidity** → pH–between 6·5 - 7·0 (very slightly acidic),pH - between 6·0 - 6·5 (slightly acidic), pH - 5·5 - 6·0 (medium acidic) and pH - below 5·5 (strongly acidic)

(iii) **Alkalinity** → pH between 7·0 - 7·5 (very slightly alkaline), pH between 7·5 - 8·0 (slightly alkaline), pH 8-8·5 (medium alkaline) and pH above 8·5 (strongly alkaline) soil reaction is measured by pH scale.

- **Thornthwaite (1931) Temperature Efficiency Index**—

  This index is used to evaluate the linear basis increases effects of temperature.

$$= \sum_{n=1}^{12} (T - 32/4)\, n'$$

or $$TE = \frac{12}{\Sigma} (T - 32/4)n$$

where, $n = 1$, T = Mean monthly temperature (°F)

- **Photo Use efficiency (PUE)**—

$$PUE = Pi/Po \times Pa/Pi \times \beta/Pa \times 10$$

where, $Po$ = PAR (Photosynthetically Active Radiation)

$Pi$ = PAR intercepted

$Pa$ = PAR absorbed by a crop slaid ($Gj/m^2$ Unit time)

- **Leaf/Stem Ratio of a Plant (LSR)**—

  Leaf/stem ratio of a plant

$$= \frac{\text{Leaf Dry Weight (g)}}{\text{Stem Dry Weight (g)}}$$

- **Shelling (%) in groundnut**—

$$\text{Shelling (\%)} = \frac{\text{Kernel weight}}{\text{Pod weight}} \times 100$$

- **Protein (%) in groundnut**—

$$\text{Protein (\%)} = \frac{\text{N(\%) in Kernel} \times 5{\cdot}46 \text{ (Constant/standard factor)}}{100}$$

- **Oil yield (kg/ha) in groundnut**—

$$\text{Oil yield (kg/ha)} = \frac{\text{oil(\%) in Kernel Groundnut Kernel (kg/ha)}}{100}$$

- **Protein yield (kg/ha) in groundnut**—

  Protein yield (kg/ha)

$$= \frac{\text{Protein (\%)} \times \text{Kernel yield (kg/ha)}}{100}$$

- **Weed Index (WI %)**—

  W.I. (%)

$$= \frac{\text{(crop yield in weed free plot) – (crop yield in treated plot)}}{\text{crop yield in weed tree plot}} \times 100$$

- **Weed control Efficiency (WCF)**—

$$WCF = \frac{\text{(Dry wieight of weeds in control plot) – (Dry weight of weeds in treated plot)}}{\text{Dry weight of weeds in control plot}} \times 100$$

- **Bio-Mass Duration (BMD)**—

  It is analogous to LAD.

$$BDM = [(W_2 - W_1)/2] \times (T_2 - T_1)$$

where, W = Weight, T = Time

**Tips for Beekeeping/Honey bee Culture**

- **About Honey bee dance**—Said by a German Biologist Noble Laurate for Biology—1966—Karl Von Frisch
- **'White colour'** is not seen to Honey bees (*i.e.* white colour blindness)
- **'Wriggle' dance**—When the food source is close to hive, the bees dance takes the form of figure 8 (Eight)
- **'Sickle' dance**—When the food source is at intermediate distance & use the 'Sickle' dance
- **More Vigorous dance**— When the amount of food source is rich, the dance is longer & more Vigorous
- Gradually slow dance—When food is exhausted.

**Tips-for Water & Environmental Protection**

- Safeda/Lemon Gum (**Eucalyptus citriodora**)—An Australian plant and Keekar/Bilayati Babool (Acasia-nilotica)–both-selfish trees are exploiting water in wet/masshy lands and dry area, respectively, be root-away from India, entire. This one safeda tree absorbs water equal to 6-8 mango trees. Presently, in India, ground-water table is reducing in aird/semi-arid areas. This plant should be removed. Which was brought from Australia in English period in India.
- Water hyacinth/Jalkumbhi (**Eichhornia hydrophily**) also needs to be root-away, because of excess water use.
- Blue Green Algae (BGA)—N fixer be promoted by collecting heterolyst roots & keep with Oxalic Acid & dryplants be used as spray on rice plants.

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# 16 NEW INTRODUCTION IN AGRICULTURE

## *General*

### 1 Agro - Bio - Technology

**Research & developmental steps**—In world hectarage of bio-technological crops, there had been a growth of nearly 11% during the year 2000, over the previous year, wherein, it was registered for 44·2 million hectare in 6 continents and 51% growth remained in developed countries; and on this area, **'bio-techque crops'** were raised. Such information could be made available by **"Global Review of Commercialized Transgenic Crops; 2000"**, which was prepared by "International Service for the Execution of Agro-biotech Application." This is a independent agency, which acts as monitoring of application of Bio-tech-crops for universe (global).

During 1996-2000, the growth in world area under genetically improved crops were recorded as—

| Year | Area (million hectare) |
|---|---|
| 1996 | 1·7 |
| 1997 | 11·0 |
| 1998 | 27·8 |
| 1999 | 39·9 |
| 2000 | 44·2* |

*(* during between 1999 and 2000, the growth of 11% or 4·3 million hectare recorded).*

In Argentina, during 2000, there had been a growth of 3·3 million hectare in soybean and maize and medium growth was noticed in genetically modified improved varieties of cotton; whereas, in U.S.A. (America), the growth of 1·6 million hectare in genetically modified crops was recorded.

Likewise, on an area of one lakh hectare in transgenic maize and cotton in South Africa; Cotton on 1·5 lac hectare in Australia and on 2 lakh hectare in Bt. Cotton in China was increased. Thus, in all four countries (Argentina and China both developed countries; America and Canada both Industrially developed countries), in 2000 transgenic crops of the world were raised. Now, in China, nearly on 10% area of the cotton is under transgenic crops. In Africa, there is a significant growth in banana production through bio-tech, as in Kenya. In India, research work is to be taken on **'Golden Rice'** having Beta-carotene content and that converted into Vit 'A'. It is thought by the Scientists that in children, the blindness in India is due to the deficiency of Vit 'A' and this would fullfil the requirement of Vit. 'A'. There is a need to develop Beta carotene in prevailing rice varieties like IR–64 and Pusa-1., for which Bio-tech Department Swiss Researchers and Monsanto Company will work jointly. If gets success in this research work, then, in next 5 to 7 years, the farmers would be able to grow such golden rice.

- **Crops**
  - A large number of **cotton** transgenics have been developed with Cry 1 Ac gene for resistance to **Helicoverpa armigera**.
  - Male sterile transgenic lines of mustard **(Brassica juncea)** expressing barnase gene in tapetum are being diversified into appropriate combiners, is being tested in field.
  - In bread wheat, development of varieties with dual resistance to leaf and stripe rusts using molecular marker technology were identified.
- **Bio-fertilizers**—The development of superior N-fixing micro-organisms is on priority in bio-technology. The work on Anabaena, Nostoc and Elite Azoto-bacter is in progress, besides Integrated Nutrients Management Packages for certain plantation crops to enhance the yield and saving to nitrogenous fertilizers.

- **Biological Control**—Several cost-effective, commercially viable mass-production technologies of bio-control agents/bio-pesticides have been developed and standardized.

## 2 Mexican or Pickly Poppy/ Satyanashi (Argemone mexicana L.)

The **'Episode–1998'** came in lime-light through-out the country to a wide spread incidence of a fetal disease known as dropsy. This disease is popularly known as **'Epidemic dropsy'** caused by the Mexican poppy seeds mixed with mustard seeds at the time of oil extraction. It's incidence occurred in 1926, but the adulteration level in oil was only 0·01%, whereas in 1998, it was adulterated 10 to 30% in oil. The seeds of Mexican poppy contains Allyl Iso thiocynate, having pungency. Epidemic dropsy attack takes place owing to consumption of the oil adulterated and expelled prickly seeds with mustard. In this disease, several problems in human are raised like-gastric, loss of apetite, loose motions, swelling of feet and sometimes, there develop fleshy, deep red spots inside the gums, tongue and the nose for the treatment, multi-vitamins have been found effective.

In India, this weed **'Satyanashi'** is called by various names like; Kantakushum, Kanteeli, Katara, Ban-Mirch, Sheel Kanta, Kandiyars, Bhadbhund etc., It can be seen in **rabi** (wheat), and gardens of mango, guava and **ber**, ranging from 10% (with wheat) to 40% in gardens.

It is said about its use that its stem/leaves powder is act as amendment for **usar** (Satine-alkali) soils reclaimation. It also controls **H. cajani** insect in **lobia** (cowpea) using 2% poppy, seeds extract, and also **Meloidogyne javanica** in Okra.

Certainly, **'Satyanashi'** is a weed, that struggles, with crop plants for water, plant nutrients, sunlight etc., and reduces crop yields. It can be controlled by the use of Fluroxypyr @ 3-4 kg a.i./ha (Pre-emer.) in wheat; Fluchloralin @ 0·5% in pea application and 2, 4-D (80% Na salt) at 625 g/ha as Post-emer in wheat.

## 3 Environmental Bio-technology

Application of bio-technology for industrial effluent treatment, restoration of degraded eco-systems, wastelands and mine spoil dumps; demonstration of the technology at the site of the user industry and conservation and characterization of bio-diversity using molecular tools, are the thrust areas on priority in environmental bio-technology.

## 4 EL-NINO & LA-NINO Nature's Vicious Cycle

Floods, drought, excess rainfall and unexpected rise of temperature, fire in forests/wild forests, sea-storm, earthquake etc., are considered as calamities of nature. Major components of climate like-sunlight, temperature, atmospheric effects, wind, humidity, precipitation (rainfall), clouds formation and ocean currents etc., are affected adversely by EL-NINO, resulting thereby a usual damage of human, fish, forests bio-animals-zoo, besides a loss of billion and billion dollars. On account of these, the universe as a whole is affected; for example in Indonesia and near by areas drought occured months, severe (furiously) wild/forest fires in Sumatra, Borneo and Malaysia, temperatures reached 108°F in Mangolia, Kenya's rainfall received 40 inches above normal, Central Europe suffered record flooding that killed 55 in Poland and 60 in the Czech Republic, Madagascar battered with monsoons and cyclones; damage due to Cyclones and sea-storms in Paradeep areas of Orissa in India etc., are the nature calamities and no end of these. Very recently, on 26th Dec., 2004 (morning at 6 AM), Sumatra sea Cyclone its intensity measured to about 8·9 at Richter Scale (Sunami Waves) that caused a severe damage in India particularly in coastal are of Orissa, A.P., T.N., Kerala states, Andaman & Nicobar Islands etc. and a great loss of human (die) and wealth, especially of fishermen.

The reverse effect or mechanism of EL-NINO is called LA-NINO, those happen after one-another. In last 15-20 years in the world, the effects of LA-NINO were seen for the first time in 1982-83, second in 1986-87 and later in 1995. Since 1998, there appeared the second effect of LA-NINO. The effects of LA-NINO are observed less clear than the effects of EL-NINO; wherein (LA-NINO) atmospheric pressure reaches unexpacted high. The U.S. National Oceanic and Atmospheric Administration (NOAA) first announced a possible EL-NINO as early as April, 1997; Australia and Japan followed a month later. The scientist and statisticians of Meteorology Departments do not distinguish between EL-NINO and LA-NINO, but both are similar/or one.

Climate Modelling, Software are being prepared with the help of Atmospheric Physics.

According to Ants Leetmaa, Director, NOAA's Climate Prediction Centre, in last 98 years, EL-NINOs happened 23 times and LA-NINO nearly 15 times, resulting thereby, there appeared a happy change in the trends of rainfall and temperature from one decade to second decade. It is expected that in last 100 years, the global temperature has gone-up high 1/10th of a degree Fahrenheit (F) temperature. Are the scientists be able predict early in advance before any calamity happens ? It is deficult to say, yes. In general, the awareness and know-how for precautions are given only, after EL-NINO or LA-NINO happens, so that the human, animals may be saved through losses.

## 5 Need of Organic Farming for Sustainable Agriculture & Ever-Green Revolution

- By 2025, in India's population, it is expected to increase 15 crore human, which will require additional 32·5 crore tonnes of foodgrains, keeping in view of present level of production, we have to increase every year an additional foodgrains of 50 lakh tonnes, which could be added 31 lakh tonnes each year within last 40 years. Since, the per capita land availability is decreasing fast, which was 0·48 hectare in 1981, and reduced to 0·15 hectare in 2000. On the gate of 21st centuary, today it is difficult task to Indian Agriculture for providing **'Food Safety and Nutritional Security'**. In fact, the **Green Revolution'** was achieved on account of fertilizers, improved & HYV's of crops, irrigation facilities-expansion in rice and wheat areas. But, the present day agriculture has gone fertilizers and pesticides (insecticides, fungicides and herbicides) based. In controlling insects-pests and diseases, heavy-use of pesticides is practised; resulting adverse effects on human health and creating environmental pollution. Nearly, more than one lakh ton pesticides is being used every year in Indian Agriculture. The answer of this problem is to adopt organic farming, integrating fertilizers and organic manures like-FYM, compost, oilcakes, vermi-compost etc., and reducing pesticides use.
- With the excessive use of fertilizers and chemicals (pesticides–fungicides, insecticides and herbicides), the adverse effects are appeared; some of those are; increased in toxicity of soil-residuals of pesticides, **'aminase'** production due to nitrogenous fertilizers created cancer problem in human, bad effects of pesticides residues on human body *viz.*, on central nervous system, respiration system, and gastro-intestinal system; human depression, etc., the earth-worms are not present in soil due to these chemicals application. The production (release) of **'Green House Gas'** *i.e.*, Nitrogen Oxide due to fertilizers application in soil, is damaging the Ozon layer and increase in **Global** temperature.
- **Major Steps of Organic Farming**—(i) Use of organic manures and bio-products in place of fertilizers; (ii) Application of **'ITK'** (Indigenous Technical Knowledge) (iii) Controlling insect-pests, diseases and weeds through IPM–Integrated Pest Management adoption, or Bio-control Systems, in place of chemicals, (iv) For improving soil health and productivity, application of wide management techniques.
- **In Principles of Organic Farming**—Get the advantage of nature gifted soil in agriculture; thinking soil-as viable system; farming systems be based on internal understanding of natural system; maintaining soil fertility through bio-systems using bio-fertilizers, bio-pesticides etc., There is a proverb for soil; **"A soil without manure is as useless as a cow without Calf."** Thus, soil should be fertilized through organics for sustainable agriculture.
- **Essentials for Sustainable Agriculture**—Stages of Agricultural development in India has remained as; (i) Pre-Green Revolution, (ii) Green Revolution, (iii) Post-Green Revolution and (iv) Commercialization–In commercialization, there is a need of further diversification of cropping pattern from low to high value crops for value addition. In fact, sustainability in crop yields has come-up in **'Post-Green Revolution'***i.e.*, mainly after 1985 to till date. This requires now; (i) Integration of organic manures like–FYM, Compost, Vermi-compost, **'NADEP'** Composting, oil cakes etc., with fertilizers; (ii) Use of Bio-fertilizers like; Azotobacter, Azospi-

rillum, PSB–Phosphate solubilizing Bacteria; BGA–Blue Green Algae; Azolla, VAM etc., Therefore, in this context, several National & International Seminars/Symposium/Worshops etc., are being held in the country in SAU's (State Agricultural Universities) / ICAR Institutes & International Centres related to Agriculture.

Heavy use of pesticides in agriculture / farming system has created several problems. To discourage its application, organic farming is the only answer. It has been reported by UNEP (United Nations Environmental Programme) that the maximum DDT content was found in Indian Women-milk. Besides; the farmers used to spray of chemicals, are affected 29·8% due to intestinal problems. Similarly, in a survey, it was reported that out of 200 cancer cases in human, 0·5% (say one case) is affected by use of chemicals.

## 6 Use of Bio-Pesticides in Controlling Insect-Pests

In present day agriculture, pesticides are being used in excess, resulting thereby exerting adverse effect on human health. keeping in view this, several new medicines based on extract of plants/plant materials are being prepared. Obviously, one of these medicines is; calisena SD–bio-formulation, that controls the harmful pathogens in soil; has been developed. This has been prepared by fungus and special strain of aspergillus niger. Today, several plant extracts or bio-pesticides have been prepared like; neem, mentha, tobacco, garlic, chilli, etc., some of these are;

- Keep one part cow-urine + 1/4 part neem leaves (green) + one piece of copper is one pot, put in soil and covered, for 15 days to one month, there after, boil the solution till remains 50%; say 1/2 and get it filter. The extract (bio-pesticide) can be used as spray by adding 50 to 100 times of water.
- Neem (seed) oil (0·03%) @ 2-3 ml/litre water, sprays on mustard for controlling Aphids is appeared useful and effective and no harms to parastic-predators like; 7 spotted worm (lady-bird beetle).
- **Tobacco brew**—Tobacco leaves, stem or dust are placed in a container. Boiling water is added into the containor, which is immediately covered. After 14 hours, the extract is ready. Dilute the extract with 4 parts of water. Use this spray only when insects are a serious problem, since this brew kills insects.
- **Custard Apple**—Seeds are pulverised and mixed with water. Use as spray against aphids, ants and other insects.
- **Garlic, Onion and Pepper brew**—Chop and boil onions, garlic, and red pepper in water for 1-2 minutes, grind/blend the material. Dilute this with 1/4$^{th}$ times of water. Then, pour/spray on plants.
- **Wood ash**—Vegetable seeds, especially cucurbits can be stored with wood ash safely for a longer period. This (wood ash) can also be used in spray;

  Spray a mixture of wood ash and water-for flea beetles.

  Spray equal quanty of wood ash and lime powder with soapy water.

## 7 ITK–Indigenous / Inherited Techni-cal Knowledge / Know-how

The farmer's-own experiences, that have been obtained from generation to generation, is called Indigenous/Inherited Technical Knowledge/ or Know-how (ITK). If the farming is done on the basis of these experiences coupled with frontier/ advanced/developed technologies, only then, the foodgrain production may be doubled in next 10-15 years of the country.

Followings are some of the ITK's—

### (1) ITK's in storage

- **In Foodgrains Storage (Wheat)**—Adopt any **one** of the following—
  - (i) Neem leaves @ 5 kg / q grain,
  - (ii) Garlic-bulblets (putti) @ 1·5 kg /q,
  - (iii) Turmeric powder - 100 g /q,
  - (iv) Lime @ 250 g/q,
  - (v) Asafoetida (Heeng) @ 3 g/q,
  - (vi) Parad Teekadi (mercury) tablets-2 tablets/q,
  - (vii) Corn cob (without grains) ash @ 200 g/q,
  - (viii) Wood-ash @ 250 g/ha, or
  - (ix) 2 Match box-spokes 100 (50 in nos in a match box) /q.
  - (x) Mentha tablets—(T–14)

(xi) Neem (Azadirachta sps) Tablets—T-31 [Mentha & Neem Tablets/say these 2 formulations prepared by CIMAP, Lucknow (UP), Total 63 types of safe tablets have been formulated.]

- **For Rice Storage**—
  (i) Common salt–15-20 pieces/q,
  (ii) Deshi Ghee @ 50 g per 1-1·5 q rice
  (iii) Rice weevil (**Sitophilus oryzae**) Tablet—T-45.
  (iv) Rice Moth—T-51 (both prepared by CIMAP, Lucknow)
  (**Note**—With these use, rice & wheat can be stored safely upto 3–6 months).
- **For Pulses (dal)**—
  (i) Asafoetida (Heeng) @ 5-6 g/q,
  (ii) Use of mustard oil while making dals.
- **For Sesamum (Til)**—
  Castor seeds : @ 4-5 seeds / kg til.

**(2) Crop Based ITK**

- **In mustard**—
  (i) Thinning at 15-18 DAS to maintain 15 cm plant to plant distance, say 1·5 lac plants/ha–increased yield by 5-10%
  (ii) De-topping at 35-40 DAS by sticks (bamboo/arhar sticks) – increased yield by 10-15%
  (iii) Seed treatment with 1% garlic-lets (putties) extract, or spraying on standing mustard crop, helps is effective to control-diseases like-white rust, stem rot (Sclerotinia), Alternaria blight and downy mildew.
  (iv) Two drops of Soybean oil on heads of Broomrape (Orobanche) are effective to control this total root parasite.
- **In Wheat**—
  (i) Criss-cross (+) sowing of wheat reduces weed density/ sq. m. area.
  (ii) **Phalaris minor (Genhu Ka mama)** can be controlled by changing the crops rotation *e.g.*, berseem, mustard, potato etc., in place of wheat in crop rotation.
- **In Gram**—
  (i) **Nipping** before flowering and tops can be used as vegetable,
  (ii) Seed treatment by butter-milk controls 'Wilt' disease.

**(3) General ITK**

- **For Field Rats**—Use of Besharm **(Ban Akaoa)** is beneficial for controlling field rats. While for house-rats, keep raw papaya fruit/or pepain, due to this, teeth of rats would be useless and will run away (out) from house.
- Use of Vinegar (Sirka), Jaggery (Gur) and Aniseed (Funnel or Sonf) helps in pickles **(achar)** preservation.
- Growing **marigold** with vegetables/cereals, helps to control root-knot nematodes; *e.g.*, in tomato, brinjal, beans, **Okra**, wheat (in hills) etc..
- Several diseases can be controlled by **Soil-amendments.**, like—
  (i) Potato **'black scruf'**—by wheat straw, saw dust, oilcakes etc.
  (ii) Potato **'Common Scab'**—by Green manure of soybean
  (iii) Root-Knot Cyst (Nematode)–by oil cake, saw dust,
- **Date of Sowing**—can control the crop diseases like—
  **Sesamum Phyllody**—Sowing be done after 15th July, in place June.
- **Use of decoy and trap crops**—Orobanche (Broom-rap) a root parasite weed in tomato, tobacco and mustard-taramira can be controlled by sunflower, safflower and gram, as well by any vegetable oil except of that family *e.g.*, if it is in mustard crop-Orobanche-can be controlled by Neem oil, (not by mustard oil) and 5-6 drops of soybean oil.
- **Mixed Cropping**—Rhizoctonia root-rot of cotton can be controlled by mothbean as mixed crop with cotton.
- **Crop Rotation**—With the change in crop rotation, verticillium **'Wilt'** of cotton by rice; Tomato bacterial **'Wilt'** by sorghum, **'Wilt'** of pigeonpea by sorghum; **'Collar rot'** of groundnut by bajra, sorghum and maize, etc.
- Motha grassnut (Cyprus rotundus) can be controlled by Peepal tree leaves-make compost and use in crop as well as 3 years til (sesame) crop take in rotation.
- Amarbel (cuscula) stem parasite on tree and berseem can be controlled by butter milk spray.

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# 17 AGRICULTURAL ENGINEERING

The use of improved implements in agriculture is increasing day-to-day, hence it has gone essential to know the maintenance of implements, method of use etc. to the farmers. The study of implements and tools related to agriculture is the objective of agricultural engineering. Agricultural engineering as defined by international institutions, comprises four main branches, mainly—(a) Farm implements and power, (b) Rural electricity, (c) Soil conservation, drainage and irrigation, and (d) Rural structures. In recent years, agricultural engineering has contributed considerably to agricultural production in the country both directly and indirectly. The number of modern machines used in agriculture is a fairly good index of the progress made during the Five Year Plans. Roughly about one lac tractors, power fillers, garden tractors are in use in Indian agriculture.

Generally, agricultural implements and tools are classified in *two* categories, namely—(i) Implements driven by the farmers themselves, *viz.*, *Khurpi*, spade, kassi, hand-hoe, kodali etc., and (ii) Implements driven by cattle, diesel engine or required power of tractor, *e.g.*, plough, harrow, cultivator etc.

The most useful implement is deshi plough, out of the agricultural implements and is drawn by the bullocks/he-buffalo. It is used by the farmers for field preparation, digging to soil and to pulverize it before seed sowing. The ploughs are also driven by tractor. Thus, these ploughs are of two types. Deshi plough makes 'V'-type of furrows and between two furrows, the unturned soil is left. Thus, cross ploughing (+) of the field is essential through deshi plough. To overcome this defect of deshi plough, soil turning plough is used.

## *Material Used in Manufacturing Agricultural Implements*

Following materials are being used in agricultural implements—

### (A) Non-metallic Materials

Like; wood, rubber, plastic, leather etc.

(1) **Wood**—Generally neem, babool, sagon, sheesham, bamboo, mahua woods etc. are being used in different implements/tools, *e.g.*, sheesham wood in planker (Patela), sagon/sheesham wood in plough's beam, bamboo wood in Chonga (*nai*), babool wood in plough-yoke. etc.

(2) **Rubber**—It is used in agricultural tools like; trauly, bullock-carts tyre tube, washer belts etc.

(3) **Plastic**—It is being used in tubes of seed-drills, sprayers etc.

(4) **Leather**—Used in washers, charsa of irrigation, swing basket (*bedi*) and belts.

### (B) Metallic Materials

(1) **Iron**—These are of various types like—

(i) **Cast-iron**—Having 2·2-4·3% carbon and 1-3·5% silicon, and also Mn, S and P contents. It is used in chaff-cutter, cane-crusher, shares of small ploughs, mould board ploughs and frog manufacturing. It has **5** kinds—White cast-iron (2-4% carbon); Gray cast-iron (3-4% carbon), Mottled cast-iron, Malleable cast-iron and Chilled cast-iron.

(ii) **Wrought-iron**—It is pure iron, having 0·05-0·10% carbon and used in rods, bolts, plates, wires, chains, hammers etc. Such iron is fibrous, highly elastic, easily turn in quality.

(iii) **Steel**—It is mid-type of cast and wrought iron, besides hard, 0·15-0·5% carbon. Generally steels are of 4 types like; **Dead Mild Steel** (carbon below 0·15%)—For sheets and wires making; **Mild Steel**—0·15 to 0·5% carbon—for rods, plates, wires etc. manufacturing; **Medium Carbon Steel**—0·3-0·8% carbon—used in springs, handles, nut-bolts etc. and **High Carbon Steel**—0·8-1·5% carbon—used in tynes, drills, shear blades, screws, dies, planer etc.

(iv) **Soft Centre Steel**—High carbon steel layers are kept on both sides over a soft layer, *e.g.*, plough bottom and shares of cultivator.

**Alloy Steel**—In this group, apart from iron and carbon, sulphur, phosphorus, nickel, chromium, molybdenum, banadium etc. are also mixed in various ratios. Major alloy steels are—

(i) **Nickel Steel**—Used in sheets, pipes, shafts, electric wires, micro measuring tools etc.

(ii) **Chromium Steel**—Mainly used in balls, bearings, tynes, hammers, files etc.

(iii) **Tungsten Steel**—Used in fast speed running tools, cutters and dies.

(iv) **Boron Steel**—Used in shafts, cap screw, stud etc.

(v) **Manganese Steel**—Cranks and connecting rods are made-up of such steel.

**Alloy**—Materials having properties of metallic and made-up of two or more than two chemical elements like; brass (Cu + Zn), bronze (Cu + Fe), magnesium (Cu + Ni + Lead) etc.

**Non-ferrous Metals**—None effect of magnate on the metals like, Cu, Zn, tin, Mg, Al, bronze etc.

# *Tillage*

The word tillage is referred to **'To-Till'**, meaning thereby to make soil easy for proper sowing, germination/growth of crops/plants through cutting/earthing/turning or scrapping the soil. It includes the agricultural processes like; ploughing, harrowing, cultivating, planking, rolling, earthing, weeding, interculture etc.

## Types of Tillage

(i) **Primary Tillage**—Mechanical operations performed before seed sowing in field.

(ii) **Secondary Tillage**—All the operations done from seed sowing to crop harvest, like-moisture conservation operations, inter-culture operations, breaking hard crust formed due to irrigation or rains in the soil.

## Modern Concept of Tillage

Farmers have their own opinion that more the field ploughings higher the crop yields since long, but today it is not true. Agricultural researches conducted on tillage show that if weeds are controlled chemically, then hardly 1-2 ploughings are required to tilth soil. Thus, according to the modern concept **'Minimum or Zero tillage concept'** has been developed. Here, zero tillage means not for **zero** but near to zero, say; minimum tillage. Surely, zero tillage in terms of changes in the cost structure, returns and resource use efficiency, cost saving (25% atleast) is better than conventional tillage.

## Draft of Implements

The draft of implements is measured by Dynamometer and its shape is like clock. The draft or power may be worked-out as—

$$\text{Draft (per cm}^2) = \frac{\text{Total draft (kg)}}{\text{Cross-section of furrow (cm}^2)}$$

## Agricultural Implements

There are three types of ploughs, used in ploughing, *viz.*, (i) Deshi plough, (ii) Soil turning ploughs and (iii) Disc ploughs.

(i) **Deshi plough**—It cuts the soil in 'V'-type, having 10 kg weight, 80 kg total draft; working efficiency—0·33 ha/day; and furrow cut size—10 × 8 cm. All parts are made-up of wooden, except share (high carbon/mild steel).

(ii) **Soil turning ploughs**—The mould board present in ploughs turns the soil. These ploughs are of two types—

(a) **One handled plough**—*e.g.*, Meston, Praja, Wah-Wah, Gurjar, Shabash ploughs, Care plough.

(b) **Double handled ploughs**—*e.g.*, Punjab, Victory ploughs, Turn-wrest plough, U. P. No. 1 plough, U. P. No. 2 plough.

**Harrow**—These are used as secondary tillage implements. The types of harrows are—

(1) **Disc harrow**, (2) **Drag harrows**—(i) Spike tooth harrow, (ii) Spring tyne harrow, (iii) Peg harrow or triangular harrow, (3) **Blade harrow** (or Bakhars), (4) Rajasthan harrow, (5) Chain harrow.

**Disc harrow**—(i) Single disc harrow, (ii) Double action disc harrow, (iii) Offset harrow.

**Hoe**—(i) Singh hand-hoe, (ii) Sharma hand-hoe, (iii) Akola hoe, (iv) Paddy weeder, (v) Wheel hand-hoe, (vi) Rake.

**Cultivators**—Mainly used in secondary tillage. These are classified as—

(A) **Based on farm Power**—(i) Hand operated cultivator, (ii) Animal operated cultivator and (iii) Tractor drawn cultivator.

(B) **Based on Structure**—(i) Shovel cultivator, (ii) Disc cultivator and (iii) Surface cultivator.

**Cultivators used in U. P.**—(i) Mecormic cultivator, (ii) Kanpur cultivator, (iii) Shabash cultivator, (iv) Wah-Wah cultivator, (v) R. N. cultivator.

**Human Operated Interculture Implements**—(i) Khurpi, (ii) Spade, (iii) Kodali, (iv) Naini type hand-hoe, (v) Singh hand-hoe, (vi) Sharma hand-hoe, (vii) Wheel hoe, (viii) Akola hoe, (ix) Paddy weeder.

**Levelling tools**—Planker is made-up of wooden logs, having life—10 years, length—3 metre (drawn by 2 pairs of bullocks) and 1·5 to 2·0 metre (by one pair of bullock).

**Roller**—Used in areas of dry farming and made-up of wooden and stone or concrete width of roller—3 metre.

**Scraper**—Used as soil-leveller and made-up of 3 mm thick steel-sheet.

**Implements of Seed Sowing**—(i) **Deshi plough**—0·33 ha/day efficiency, (ii) **Cultivators**—Efficiency 0·8 ha per day, (iii) **Dibbler**—Efficiency 0·1 ha/day, (iv) **Seed-drill**—Efficiency 1·8 ha per day.

**Seed-drills**—Seed-drills may be classified as—

(a) **According to Power used**—(i) Hand operated (manual) machine, (ii) Animal drawn machine and (iii) Tractor drawn machine.

(b) **According to seed-dropping Method**—(i) Feed cup, (ii) Fluted Roller Feed, (iii) Double Run Force Feed, (iv) Variable Orifice Type.

**Crop Harvesting Machines**—Generally crops are harvested by machines and sickles. Under machines, mowers are used; drawn by animals and tractor drawn—trailed, semi-mounted and mounted type.

**Threshing and Winnowing Machines : Threshing**—Harvested crops are generally threshed by three means, *viz*., (i) Threshing by beating through woods, (ii) By bullocks and (iii) Olpad thresher—Efficiency one acre harvested crop in 4 days—one pair of bullock and one man used. On large farms, combines are used for threshing the crops.

**Winnowing**—Winnowing fans are generally used.

**Blacksmithy Tools**—(1) Smith's forge, (2) Anvil, (3) Poker, (4) Tongs, (5) Punches, (6) Sledges, (7) Files, (8) Vice, (9) Plier, (10) Bick iron, (11) Working table, (12) Hack saws, (13) Chisels, (14) Hammers, (15) Cutting tools, (16) Swage block.

## Carpentary Tools—

(i) **Marking and Measuring Tools**—(1) Try square, (2) Mitre square, (3) Spirit level, (4) Marking guage, (5) Marking knife, (6) Tape, (7) Compasses, (8) Bevel square.

(ii) **Toothed Edge Cutting Tools**—(1) Rip saw, (2) Key hole saw, (3) Bow saw, (4) Country made saw, (5) Tenon saw, (6) Compass saw, (7) Dovetail saw, (8) Freat saw machine.

(iii) **Pairing Tools**—(1) Adze, (2) Curve Adze, (3) Chisels.

(iv) **Planning Tools**—(1) Jack plane, (2) Iron plane, (3) Compass plane, (4) Trying plane, (5) Toothing-plane (6) Rebate-plane.

(v) **Rasping Tools**—(1) Files, (2) Flate file, (3) Half-round file, (4) Triangular file, (5) Square file, (6) Round-file, (7) Needle file and (8) Wood rasp file.

(vi) **Striking Tools**—(1) Mallet, (2) Cross Peen Hammer, (3) Nail Punch.

(vii) **Boring Tools**—(1) Brace machine, (2) Centre bit, (3) Auger bit, (4) Twist bit, (5) Auger, (6) Ordinary drill.

(viii) **Holding Tools**—(1) Bar cramp, (2) Hand screw, (3) Bench vice.

(ix) **Driving Tools**—(1) Claw hammer, (2) Pinch, (3) Nail puller, (4) Screw driver.

(x) **Supporting Tools**—(1) Bench hook, (2) Pin board, (3) Working Bench/table.

**Sprayers**—(i) Hydraulic sprayer—bash (a) High pressure and high volume sprayer, (b) Low pressure and low volume sprayer.

(ii) Hydropneumatic sprayer, (iii) Blower sprayer and (iv) Aeroplane sprayer.

**Dusters**—(i) Hand duster, (ii) Power duster, (iii) Aeroplane duster.

**Sources of Agriculture Power**—(i) Human power, (ii) Animal power, (iii) Mechanical power, (iv) Electric power, (v) Wind power, (vi) Hydraulic power.

| Agricultural Engineering & Technology Institutes in India | | |
|---|---|---|
| **S. No.** | **(i) Institution** | **Abbreviation** |
| 1. | Central Institute of Agricultural Engineering (CIAE), Bhopal (M. P.) | CIAE |
| 2. | Water Technology Centre, Indian Agricultural Research Institute (IARI), New Delhi | WTC |
| 3. | Central Institute of Post-Harvest Engineering & Technology, Ludhiana (Punjab) | CIPHET |
| 4. | Water Agriculture Land Management Training & Research Institute, Hyderabad (A. P.) | WALMTARI |
| 5. | Tractor Training & Testing Centre (ICARI), Budani (M. P.) and Hisar (Haryana) | TTTC |
| 6. | National Research Centre of Water Technology for Eastern Region, Bhubaneshwar (Orissa) | NRC-WT-ER |
| 7. | College of Agriculture Engineering & Technology of All the SAU's of the country | CAE-T |
| | **(ii) Project Co-ordinating Units of ICAR related to Agricultural Engineering** | |
| 1. | Project Co-ordinator (Agricultural Drainage) Water Technology Centre (WTC), IARI, New Delhi. | PC-AD-WTC |
| 2. | Project Co-ordinator (Energy Requirements in Agriculture Sector), CIAE, Bhopal (M. P.) | PC-ERAS |
| 3. | Project Co-ordinator (Farm Implements & Machinery Renewable Energy Sources, separately CIAE, Bhopal (M. P.) | PC-FIM-RES |
| 4. | Project Co-ordinator (Human Engineering & Safety Studies in Agriculture), CIAE, Bhopal (M. P.) | PC-HE-SS-A |
| 5. | Project Co-ordinator (Organic Farming and Utilization of Animal Energy separately), CIAE, Bhopal (M. P.) | PC-OFU-AE |
| 6. | Project Co-ordinator (Application of Plastics in Agriculture, CIPHET, Ludhiana (Punjab) | PC-APA |
| 7. | Project Co-ordinator (Power Tillers), CIAE, Bhopal (M. P.) | PC-PT |
| 8. | Project Co-ordinator (Processing, Handling & Storage of Jaggery & Khandsari, Indian Institute of Sugarcane Research (ICAR), Lucknow (U. P.) | PC-PHS-JK |

## *Soil Survey*

**Tools/Methods used in Soil Survey**—(1) Pacing, (2) Speedometer, (3) Chain surveying—(i) Engineer's chain, (ii) Gunter's chain, (iii) Meteri-chain, (4) Tape (cotton, metal, steel tape etc.), (5) Pegs, (6) Ranging rod, (7) Ranging pole, (8) Offset rod, (9) Sahul, (10) Gunia.

**Types of Soil Survey**—(i) Plane survey, (ii) Geodetic survey.

**Types of Plane Survey**—(i) Chain surveying, (ii) Compass surveying, (iii) Plane table surveying.

## *Agricultural Implements Manufacturing Companies & Their Availabilities*

### (A) Tractors

1. Hindustan Ltd., Vishwamitri, Baroda (Gujarat)
2. Eicher Tractor India Ltd., New Industrial Town, Faridabad (Haryana)
3. International Tractor Company of India, Post Box No. 7665, Kurli Road, Kandivilli (East), Mumbai—67 (Maharashtra)
4. Tractor & Farm Equipments Ltd. Post Box No. 3302, Chennai—34 (Tamil Nadu)
5. ESCORT Ltd., Faridabad (Haryana)
6. Mahindra & Mahindra Company
7. Central Institute of Agricultural Engineering (CIAE), Bhopal (M. P.)

### (B) Power Tillers

1. Nishiman & Company, Sunder Nagar, New Delhi
2. J. K. Sato Agri. Machine Ltd., Kanpur (U. P.)

## (C) Seed-drills

1. Bharat Engineering Works, Moga (Punjab)
2. Matfub India Pvt. Ltd. P. B. No. 78, Barnaba Road, Meerut (U. P.)
3. Layalpur Engineering Company, Ghaziabad (U. P.)

## (D) Potato Digging Machines

1. Swadeshi Agriculture Implements Industry, Sitapur (U. P.)

## (E) Chaff-cutters

1. Layalpur Engineering Company, Ghaziabad (U. P.)
2. Ajay Industry, Chandausi (U. P.)

## (F) Farm Protection Tools

1. M/s Gopaldas Khandelwal, Virhana Road, Kanpur (U. P.)

**Power Tiller Manufacturing Companies/Organizations**

| S. No. | Power tiller organization | Brand Name | Horse Power |
|---|---|---|---|
| 1. | Krishi Engines Ltd., Hyderabad (A. P.) | Krishi (AK ITU) | 5-7 H.P. |
| 2. | VTS Tillers Tractors Ltd., Bangalore (Karnataka) | Missubishi | 10 H. P. |
| 3. | J. K. Satoh Agri .Machines, Kanpur | Satoh | 6 H. P. |
| 4. | Kerala Agro Industries Corp. Ltd., Trivendrum (Kerala) | Kubota | 12 H. P. |
| 5. | Indequip Engineering Ltd. Ahmedabad (Gujarat) | Iseki | 8 H. P. |
| 6. | Maharashtra Corporative Engineering Society, Sirohi | Yanmar | 10. H. P. |

# Objective Questions

1. The main advantage of **'PVC'** pipes for drainage is the feasibility of—
   (A) Mechanical laying
   (B) Physical laying
   (C) Chemical laying
   (D) Physical, chemical laying both
   (E) None of these
2. **'ESCORT'** tractor is manufactured at—
   (A) Faridabad (B) Ghaziabad
   (C) Kanpur (D) Chennai
   (E) None of these
3. Soil erosion by wind brings about the serious damage in soil by changing the—
   (A) Soil permeability
   (B) Soil structure
   (C) Soil texture
   (D) Soil plasticity
   (E) Soil cohesion
4. High compression petrol engines are used in some tractors and have high performance in—
   (A) U.S.A. (B) Germany
   (C) Japan (D) Holland
   (E) India (F) China
5. The distribution of fertilizers by aircraft is widely practised in—
   (A) England (B) France
   (C) Germany (D) New Zealand
   (E) India
6. A 2- row potato harvester, working in good conditions with 4 to 5 men on the machine, can do how much hectare per day ?
   (A) 0·5-0·6 ha (B) 1·2-1·4 ha
   (C) 2·5 ha (D) 1·8-1·9 ha
   (E) Above 3·0 ha
7. Mole drainage is practised extensively in country—
   (A) New Zealand (B) Japan
   (C) U.S.A. (D) China
   (E) None of these
8. Which is not included in the sources of energy, getting for agricultural work ?
   (A) Diesel engine (B) Electric motor
   (C) Bullocks (D) Cow
   (E) Camel
9. Which is included in dairy equipments ?
   (A) Threshers (B) Lactometer
   (C) Cane Planter (D) Winnowers
   (E) Chaff-cutting machine

10. In our country, for the manufacturing of agricultural implements tools, mostly wood is used, because—
    (A) Easy available at all the places
    (B) Wood is cheaper
    (C) Easy to repare tools made-up of wooden, compound to metal tools
    (D) None of the above cause is correct
    (E) Above (A) to (C) are correct
11. Which of the following wood is not used for making handle of spade ?
    (A) Sheesham (B) Babool
    (C) Neem (D) Mango
    (E) Bamboo
12. Soil turning plough makes the furrow of which type (shape) ?
    (A) 'V' shape (B) 'L' shape
    (C) 'O' shape (D) No definite shape
    (E) This plough does not make any furrow
13. Which of the following is one (single) handed soil turning plough ?
    (A) Punjab plough
    (B) Praja plough
    (C) Victory plough
    (D) U. P. No. 1 plough
    (E) U. P. No. 2 plough
14. The purpose of tillage is/are—
    (A) Soil clods breaking and suppressing in soil
    (B) Eradication of weeds
    (C) Leveling of soil
    (D) Above (A), (B) and (C)
    (E) Above (A) and (B)
15. The main function of cultivator is—
    (A) To turn the soil
    (B) To make furrow in soil
    (C) To pulverize the soil
    (D) All above three functions
    (E) None of the above work
16. **Bakhar** is generally used in—
    (A) U. P.
    (B) Bundelkhand
    (C) Vindhya Pradesh
    (D) In all the States/parts of India (in All India)
    (E) None is such implement.
17. **Harrow** is drawn by—
    (A) Bullocks
    (B) Tractor
    (C) Diesel
    (D) Bullocks and Tractor both
    (E) It is automatic tool
18. Which of the following is not a secondary tillage implement ?
    (A) Cultivators (B) Harrow
    (C) Hoe (D) Meston plough
    (E) Bakhar
19. The term **'Olpad'** in **'Olpad Thresher'** is named on the name of—
    (A) Scientist (B) Village
    (C) Labourer (D) Farmer
    (E) None of the above
20. Which of the following **'hoe'** is bullock drawn ?
    (A) Akola hoe (B) Sharma hoe
    (C) Wheel hoe (D) Naini type hoe
    (E) None of the above
21. The land levelling implement is—
    (A) Patela (B) Roller
    (C) Scrapper (D) All of the above
    (E) None of the above
22. ***Patela*** is used for—
    (A) Sowing (B) Ploughing
    (C) Earthing (D) Weeding
    (E) Levelling
23. Which of the material is not used for making rollers ?
    (A) Wood (B) Stone
    (C) Iron (D) Steel
    (E) None of the above
24. In which condition, **roller** is used ?
    (A) Where soil is wet.
    (B) Where clods are present in soil.
    (C) Where soil is friable.
    (D) Where soil is undulated.
    (E) None of the above
25. Which one of the following work is not done by scrappers ?
    (A) For levelling of soil

(B) For making irrigation channels
(C) For filling ravines and pits
(D) For making ridges
(E) For covering the sown-seeds by earth

26. **Dibbler** is used for—
(A) Ploughing
(B) Seed sowing
(C) Levelling of land
(D) Interculture
(E) In all above work

27. The minimum expenditure is incurred by implements for sowing seeds among the following—
(A) Deshi plough (B) Cultivator
(C) Dibbler (D) Seed-drill
(E) No specific difference in expenditure

28. Which of the following tool is used for measuring the draft of agricultural implements ?
(A) Dynamometer (B) Hydrometer
(C) Galvanometer (D) Barometer
(E) Lactometer

29. Which of the following does not affect the draft of ploughs ?
(A) Width of furrow
(B) Depth of furrow
(C) Length of furrow
(D) Soil moisture
(E) Sharpness of share

30. Swing-basket **(Dhenkuli)** is used for—
(A) Making furrow
(B) Lifting water from wells
(C) Destroying weeds
(D) Levelling of land
(E) Cutting the crops

31. Which of the following is used maximum for lifting water from wells ?
(A) Persian wheel (Rahat)
(B) Swing basket (Bedi)
(C) Dhenkuli
(D) Don
(E) Chain pump

32. Which of the following is used for lifting water from 8-10 m depth ?
(A) Washer Rahat (B) Hand pump
(C) Mayadar lift (D) Above all three
(E) None of the above

33. In which implement, bullocks are not used for lifting water ?
(A) Buldev Balti
(B) Charsa
(C) Egyptian screw
(D) Rahat (Persian wheel)
(E) Mayadas lift

34. The working efficiency per day of **deshi** plough is—
(A) 0·3 ha (B) 0·4 ha
(C) 0·6 ha (D) 0·8 ha
(E) 1·0 ha

35. Which of the method of ploughing is mostly practised ?
(A) Outside to inside ploughing
(B) Inside to outside ploughing
(C) Ploughing by putting furrow from one-side of field
(D) Ploughing by **halai** making
(E) All of the above methods

36. The best method of ploughing through deshi plough is—
(A) Outside to inside ploughing
(B) Inside to outside ploughing
(C) Ploughing by making **halai**
(D) Ploughing by making furrow from one side of field
(E) All of the above methods

37. How much is the working efficiency of dibbler (ha per day) ?
(A) 0·15 (B) 0·25
(C) 0·35 (D) 0·45
(E) More than 0·5

38. Tillage includes—
(A) Ploughing of land
(B) Keep the land free from weeds
(C) Make the soil levelled
(D) Weeding & digging
(E) All of the above operations

39. Function of the seed-drill is—
(A) Making furrow
(B) Dropping seeds

(C) Covering the seeds in furrow
(D) All of the above
(E) Only to sow seeds

40. Wrought iron contains carbon (per cent)—
(A) 0·05-1% (B) 1-2%
(C) 2-3% (D) 3-4%
(E) 4-5%

41. The mould-board of a tractor drawn soil turning plough is the type of—
(A) General purpose
(B) Stubble
(C) Sod (breaker)
(D) Slate
(E) High speed

42. Among the following, ridger is not used in crop—
(A) Maize (B) Gram
(C) Potato (D) Sugarcane
(E) Sweet potato

43. Belt mostly used is of types—
(A) Rubber (B) Kirmich
(C) Leather (D) Cotton thread
(E) Plastic

44. The major defects of rubber belts are—
(A) Costly
(B) Slips on wet
(C) Early rubbed
(D) Increased due to heat
(E) None defect

45. The formula used in working-out the depreciation of implement is—
(A) $\frac{\text{(Purchase price – Last price)}}{\text{Life}}$
(B) $\frac{\text{(Last price – Purchase price)}}{\text{Life}}$
(C) $\frac{\text{Life}}{\text{(Purchase price – Last price)}}$
(D) $\frac{\text{Life}}{\text{(Last price – Purchase price)}}$
(E) None of the above

46. The grooved pulleys are made-up of—
(A) Steel
(B) Cast iron
(C) Wooden
(D) Above (A) and (B) both
(E) Above (A), (B) and (C)

47. A general farmer used deshi plough for the purpose of—
(A) Land ploughing
(B) Collecting weeds
(C) Making soil powdery
(D) Sowing seeds
(E) Above all works

48. Which of the following is best for driving machine from low power to slow speed ?
(A) Belts & pulley
(B) Spur gear
(C) Toothed wheel & chains
(D) Shaft
(E) None of the above

49. Reapers are used for—
(A) Crop cutting
(B) Threshing of harvested crop produce (*lank*)
(C) Seeds sowing
(D) Fodder cutting
(E) All above works

50. Threshers (except Olpad threshers) are driven by—
(A) One pair of bullocks
(B) Two pair of bullocks
(C) Diesel
(D) Kerosene oil
(E) All of the above

51. Winnowing it called—
(A) Cutting a crop
(B) To separate straw etc. from threshed *lank*
(C) To thresh
(D) Cutting the fodder
(E) To make jaggery (*gur*) block (*bheli*) from juice of cane

52. Chaff-cutter is driven by—
(A) Hand
(B) Bullocks
(C) Electric power
(D) Diesel
(E) All of the above

53. Sugarcane juice is extracted (%) from canes through bullock-drawn cane-crusher—
(A) 50-55 (B) 70-75
(C) 25-30 (D) 60-65
(E) 80-90

54. **'Olpad'** thresher is used in—
(A) Oil extraction from mustard, toria etc.
(B) Extracting juice from cane
(C) Threshing of wheat, barley, pea etc.
(D) None of the above
(E) All (A), (B) and (C)

55. **'Seed dresser'** is used for—
(A) Mixing/treating seeds with chemicals (pesticides/fungicides etc.)
(B) Sowing seeds at proper distance
(C) Making seeds of high grade
(D) Keeping seeds effective upto longer period
(E) Separating good/quality seeds from diseased seeds

56. **'Try square'** is used by—
(A) Blacksmith (B) Carpenter
(C) Potter (D) Farmers
(E) By above all

57. Which type of saw is not included ?
(A) Cross cut saw (B) Deshi saw
(C) Tenon saw (D) Teething saw
(E) Rip saw

58. Which type of saw is used for cutting round shape in hole ?
(A) Fret saw (B) Penal saw
(C) Tenon saw (D) Cross cut saw
(E) Key hole saw

59. **'Draw-Knife'** is used for—
(A) To fit **galua** in grinder
(B) Making round the corners of wood
(C) Smoothing the base of wood
(D) Sharping teeth of saw
(E) All of the above

60. The tool used for making deep pit in wood is—
(A) Adge (B) Saw
(C) Draw knife (D) Chisel
(E) File

61. The main work of **'scrapper'** is—
(A) For cutting the wood
(B) For scrapping the wood
(C) For smoothing the wood
(D) For drilling in wood
(E) All of the above

62. **'File'** is used for—
(A) Scrapping the wood
(B) Cutting the wood
(C) Forcing the wood
(D) Making equal by scrapping the wood
(E) All of these

63. The type of file is generally—
(A) Round (B) Triangular
(C) Flate (D) Semi-circle
(E) Above all types

64. Brace machine is used for—
(A) Making hole in wood
(B) Scrapping the wood
(C) For smoothing the wood
(D) All above work
(E) None of these

65. Which one machine/tool is not used in making hole in wood ?
(A) Ordinary drill (B) Hand drill
(C) Pincer (D) Twist bit
(E) Brace

66. **'Bar cramp'** is a tool of—
(A) Wood cutting
(B) Catching tightly wood
(C) Beating tool
(D) Smoothing tool
(E) Making round end of wood

67. Nail (Keel) pulling is done by—
(A) Claw-hammer (B) Pincer
(C) Plier (D) None of these
(E) All of these

68. **'Forging'** is said—
(A) Heating the iron
(B) Beating the hot iron
(C) Converting into desired shape by beating the iron
(D) Beating iron and making hole in it
(E) For all above work

69. **'Anvil'** (*Nihai*) is used for—
(A) Beating the iron on keeping over this
(B) By beating iron through this
(C) Heating iron through handling this
(D) Cooling of hot iron
(E) Giving various shapes by beating of hot iron

70. Fire is pulled-up through—
(A) Poker (B) Sewage block
(C) Showel (D) Anvil
(E) None of these

71. **'Sledge'** is used to—
(A) Lift heavy material
(B) Fire furnace
(C) Cut the iron in cold condition
(D) Cut the iron in hot condition
(E) Put shine on chisel (*rukhani*)

72. The roller of cane-crusher is made-up of which steel ?
(A) Cast iron
(B) Gun metal
(C) High carbon steel
(D) Wrought iron
(E) Mild steel

73. The tool used for catching (handling) the claw and turning it hither and thither during beating is called—
(A) Sewage block (B) Chisel
(C) Plier (D) Tongs
(E) File

74. Punches are of—
(A) Two types (B) Three types
(C) Four types (D) Several types
(E) Only of one type

75. A mould-board plough is cutting a furrow of 20 cm width and 15 cm deep. If the soil resistance is 0·3 kg/cm$^2$, having the speed of bullocks 3 km per hour. What would be the required Horse Power (H. P.) to draw the plough ?
(A) 1·5 (B) 1·0
(C) 2·0 (D) 3·0
(E) None of these

76. A three-tine furrow plough is ploughing at a speed of 2 km/hr and the each furrow size is 20 cm wide and 12 cm deep furrow. How much time, it would require to plough 5 hectare land ?
(A) 41 hours 40 minutes
(B) 40 hours 55 minutes
(C) 20 hours 55 minutes
(D) 55 hours 55 minutes
(E) None of these

77. If a gear 'A', having 50 teeth and running at a speed of 200 r.p.m. is driving to another gear 'B' having 125 r.p.m. How many number of teeth in gear 'B' ?
(A) 500 (B) 400
(C) 80 (D) 60
(E) 30

78. A gear 'A', having 12 teeth, is driving and connecting to gear 'B' of 12 teeth. The speed of gear 'B' is 200 r.p.m. On the shaft of gear 'B' another gear 'C' is attached having 12 teeth, which is driving to a separate gear 'D'. If gear 'D' has 6 teeth, what would be the r.p.m. (revolutions per minute) of last gear ?
(A) 600 r.p.m. (B) 530 r.p.m.
(C) 250 r.p.m. (D) 300 r.p.m.
(E) 400 r.p.m.

79. A 10 cm wide belt is running at a speed of 900 r.p.m. If the 15 H. P. is available, then how much plies of belt ?
(A) 3 (B) 10
(C) 6 (D) 8
(E) 4

80. How much width belt would be needed if 20 H. P. is to be transferred through a belt of 10 plies, where speed of belt is 1460 r.p.m. ?
(A) 4 cm (B) 10 cm
(C) 5 cm (D) 6 cm
(E) 8 cm

81. A 10 cm wide belt, having the speed of 1350 metre per minute, would be appropriate to transfer the how much H. P. ?
(A) 20 (B) 15
(C) 25 (D) 40
(E) 30

82. A tractor driving pulley has its 25 cm diameter and revolving at a speed of 960 r.p.m. If on the shaft of a thresher, an attached pulley is revolv-

ing at a speed of 1600 r.p.m. what would be the diameter of this pulley ?

(A) 16 cm (B) 15 cm
(C) 12 cm (D) 20 cm
(E) 18 cm

83. A pulley of 21 cm diameter and revolving at 1600 r.p.m. Find out the speed of the belt running over it.
(A) 1120 m/minute
(B) 1200 m/minute
(C) 1056 m/minute
(D) 840 m/minute
(E) None of these

84. If the distance between two pullies, having the diameter of 45 cm and 39 cm, is 3·2 metre, then what would be length of required flate belt ?
(A) 6·8 m (B) 7·72 m
(C) 9·4 m (D) 7·2 m
(E) 8·4 m

85. Two pair of bullocks are ploughing a field by victory ploughs at a speed of 2 km/hr. If the average width of each furrow is 25 cm. How much time will be required to plough one hectare land ? Where after each two hours working, 20 minutes rest is required to provide ?
(A) 10 hours
(B) 8 hours
(C) 11 hours 40 minutes
(D) 8 hours 20 minutes
(E) 11 hours

86. If the relative distance is 2·5 metre of centre points of two pullies, having 50 cm and 25 cm diameters, then, how much length (metre) of 'V' belt would be required ?
(A) 6·18875 (B) 5·18775
(C) 6·28775 (D) 6·18775
(E) 5·28775

87. Which of the following formula is correct (true) for calculating the horse power (h.p.) of pump in irrigation, if discharge of water (cubic metre per second) is denoted by 'D' and pump efficiency (P. E.)—
(A) $hp = \frac{50 \times D \times H}{75 \times PE}$
(B) $hp = \frac{75 \times D \times H}{44 \times PE}$
(C) $hp = \frac{100 \times D \times H}{44 \times PE}$
(D) $hp = \frac{1000 \times D \times H}{75 \times PE}$
(E) $hp = \frac{44 \times D \times H}{550 \times PE}$

88. If the rate of electricity is rupee one per unit, then, a 20 h. p. electric motor, having approx. 100% efficiency will require how much cost (Rs.) on 100 hours running to irrigate the field ?
(A) 500 (B) 750
(C) 1500 (D) 2000
(E) 300

89. **'Drip'** irrigation is generally followed in the country—
(A) Israel (B) America
(C) Australia (D) Japan
(E) Germany

90. In India, under canal net-work system of irrigation, generally, how much amount of water is allowed to run in small canal ?
(A) Less than 4 cusec
(B) Less than 10 cusec
(C) Between 15 to 20 cusec
(D) Between 25 to 30 cusec
(E) Between 35 to 45 cusec

91. Method of irrigation is—
(A) Surface irrigation
(B) Sprinkler irrigation
(C) Drip irrigation
(D) Sub-surface irrigation
(E) All of these

92. The **Torque**—a power to generate revolutions is expressed as (its unit is kg metre)—
(A) Length of arm (m) × Force (kg)
(B) Length of arm (cm) × Force (kg)
(C) Length of arm (m) × Force (g)
(D) Length of arm (mm) × Force (mg)

93. **Work** is expressed by the formula as—
(A) Work = Force (kg) × Distance (m)
(B) Work = Force (g) × Distance (m)

(C) Work = Force (mg) × Distance (m)
(D) Work = Force (kg) × Distance (cm)
(E) Work = Force (g) × Distance (cm)

94. The length of **'Engineer chain'** is—
(A) 100 ft (B) 80 ft
(C) 20 ft (D) 50 ft
(E) None of these

95. The length of **'Gunter chain'** is—
(A) 66 ft (B) 100 ft
(C) 20 ft (D) 90 ft
(E) 10 ft

96. The area of an **acre** is—
(A) 0·40 (B) 0·80
(C) 1·10 (D) 0·60
(E) None of these

97. One centimetre is equal to—
(A) 5 mm (B) 10 mm
(C) 15 mm (D) 20 mm
(E) None of these

98. The area of a hectare is equal to—
(A) 5000 $m^2$ (B) 8000 $m^2$
(C) 10000 $m^2$ (D) 400 $m^2$
(E) None of these

99. How much horse power (h.p.) is in one kW (Kilowatt) ?
(A) 1·34 (B) 1·90
(C) 2·00 (D) 3·80
(E) 2·40

100. Man power is considered equal to how much horse power (h.p.) ?
(A) 0·1 (B) 0·2
(C) 0·3 (D) 0·4
(E) 0·5

101. Animal driven cane planter is developed by—
(A) ICAR (B) CIAE
(C) IISR (D) IARI
(E) None of these

102. Agricultural tractors are generally having horse power (h.p.)—
(A) 20-50 (B) 50-70
(C) 10-15 (D) 20-25
(E) None of these

103. How many m.m. are in one foot length ?
(A) 304·8 (B) 404·8
(C) 204·8 (D) 104·8
(E) None of these

104. A **'chain'** contains how much metre ?
(A) 20·1168 (B) 21·1168
(C) 15·1168 (D) 18·1168
(E) None of these

105. The draft of **'Victory plough'** is—
(A) 80-100 kg (B) 40-50 kg
(C) 70-80 kg (D) 10-20 kg
(E) None of these

## Answers

| | | | | |
|---|---|---|---|---|
| 1. (A) | 2. (A) | 3. (C) | 4. (A) | 5. (D) |
| 6. (B) | 7. (A) | 8. (D) | 9. (B) | 10. (E) |
| 11. (A) | 12. (B) | 13. (B) | 14. (D) | 15. (C) |
| 16. (B) | 17. (D) | 18. (D) | 19. (B) | 20. (A) |
| 21. (D) | 22. (E) | 23. (D) | 24. (E) | 25. (E) |
| 26. (B) | 27. (D) | 28. (A) | 29. (C) | 30. (B) |
| 31. (A) | 32. (E) | 33. (C) | 34. (B) | 35. (D) |
| 36. (C) | 37. (A) | 38. (E) | 39. (D) | 40. (A) |
| 41. (E) | 42. (B) | 43. (A) | 44. (B) | 45. (A) |
| 46. (D) | 47. (E) | 48. (A) | 49. (A) | 50. (C) |
| 51. (B) | 52. (E) | 53. (D) | 54. (C) | 55. (A) |
| 56. (B) | 57. (D) | 58. (E) | 59. (B) | 60. (D) |
| 61. (C) | 62. (D) | 63. (E) | 64. (A) | 65. (C) |
| 66. (B) | 67. (E) | 68. (C) | 69. (A) | 70. (A) |
| 71. (A) | 72. (A) | 73. (D) | 74. (B) | 75. (B) |
| 76. (A) | 77. (C) | 78. (E) | 79. (E) | 80. (E) |
| 81. (B) | 82. (C) | 83. (B) | 84. (B) | 85. (C) |
| 86. (D) | 87. (D) | 88. (C) | 89. (A) | 90. (B) |
| 91. (E) | 92. (A) | 93. (A) | 94. (A) | 95. (A) |
| 96. (A) | 97. (B) | 98. (C) | 99. (A) | 100. (A) |
| 101. (C) | 102. (A) | 103. (A) | 104. (A) | 105. (A) |

### Tractor Operated New Implements

- **For Land Preparation**—Multipurpose equipment, furrow making, sowing & planting & interculture; twin auger, digger, lug wheel puddler, zero-till drill, inclined plate planter garlic planter, rigger seeder/raised bed planter, 3 row rotary weeder, happy seeder, turmeric harvester, flail type chopper cumspreader, flail type forage harvester–cumchopper, urea Dropper/sprayer, straw combine, maize & groundnut thresher etc.
- **"Zero-till ferti-seed drill"**—developed from GBPUAT, Pantnagar, used in wheat sown in 'rice-wheat' cropping system, keeping 4–5 cm depth of wheat seeding".
- **Olpad Thresher**—Named on a small village—**'Olpad'** in Gujarat which was firstly manufactured, in India and operated by man and drawn by one pair of bullocks.

●●●

## *Appendix* 1

# World Population Growth—Years to Next Billion and India/World Population Projections (Millions)

| World Population Growth | | |
|---|---|---|
| **Year** | **Population** (billion) | **Years to Next** (billion) |
| 1800 | 1 | 125 |
| 1925 | 2 | 35 |
| 1960 | 3 | 14 |
| 1974 | 4 | 13 |
| 1987 | 5 | 12 |
| 1999 | 6 | 12 |
| 2011 | 7 | 12 |
| 2023 | 8 | 16 |
| 2039 | 9 | 21 |
| 2060 | 10 | 43 |
| 2103 | 11 | — |

| India/World Population | | |
|---|---|---|
| **Year** | **India** (millions) | **World** (millions) |
| 1990 | 849 | 5266 |
| 1995 | 934 | 5962 |
| 2000 | 1016 | 6113 |
| 2005 | 1094 | 6527 |
| 2010 | 1170 | 6944 |
| 2015 | 1237 | 7348 |
| 2020 | 1304 | 7742 |
| 2025 | 1370 | 8121 |
| 2030 | 1432 | 8474 |

***Source*** : World Bank Statistics—World Population Projections 1994–95.

**Note**—On World Population Day (11 July), **by 2020**, ten countries will be of the largest elderly population in the world, of which, 5 countries will be in the developing world : China-230, India-142, Indonesia-29, Brazil-27 and Pakistan-18 million.

## *Appendix* 2

# India's Position in World Agriculture in 2007

| S.No. | Item | India | World | India's Position | | |
|---|---|---|---|---|---|---|
| | | | | % Share | Rank | Next to |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | **Area** (million ha*) | | | | | |
| | (i) Total Area | 329 | 13442 | 2·4 | Seventh | Russian Federation, Canada, USA, China, Brazil, Australia |
| | (ii) Land Area | 297 | 13009 | 2·3 | Seventh | Russian Federation, China, USA, Canada, Brazil, Australia |
| | (iii) Arable Land | 159 | 1411 | 11·2 | Second | USA |
| | (iv) Irrigated Area | 59 | 274 | 21·5 | First | — |
| 2. | **Population** (million)* | | | | | |
| | (i) Total | 1152 | 6593 | 17·5 | Second | China |
| | (ii) Agriculture | 585 | 2618 | 22·4 | Second | China |
| 3. | **Economically Active Population** (million) | | | | | |
| | (i) Total | 509 | 3265 | 15·6 | Second | China |
| | (ii) Agriculture | 290 | 1378 | 21·0 | Second | China |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4. | **Crop Production** (million tonnes) | | | | | |
| | (A) **Total Cereals** | 260 | 2351 | 11·1 | Third | China, U.S.A. |
| | —Wheat | 76 | 606 | 12·5 | Second | China |
| | —Rice (Paddy) | 145 | 660 | 21·9 | Second | China |
| | —Coarse grains | 31 | 874 | 3·5 | Fourth | U.S.A., China, Brazil |
| | —Total Pulses | 14 | 56 | 25·4 | First | — |
| | (B) **Oilseeds** | | | | | |
| | —Groundnut | 9 | 37 | 24·7 | Second | China |
| | —Rapeseed | 7 | 51 | 14·7 | Third | China, Canada |
| 5. | **Fruits & Vegetables** (million tonnes) | | | | | |
| | —Vegetables & Melons | 77 | 909 | 8·5 | Second | China |
| | —Fruits | 57 | 555 | 10·4 | Second | China |
| | —Potatoes | 22 | 309 | 7·1 | Third | China, Russian Federation |
| | —Onion (dry) | 8 | 66 | 12·4 | Second | China |
| 6. | **Commercial Crops** (million tonnes) | | | | | |
| | (a) Sugarcane | 356 | 1591 | 22·3 | Second | Brazil |
| | (b) Tea | 0·95 | 3·89 | 24·4 | Second | China |
| | (c) Coffee (green) | 0·29 | 7·79 | 3·7 | Sixth | Brazil, Vietnam, Colombia, Indonesia, Ethiopia |
| | (d) Jute & Jute like fibres | 2·01 | 3·24 | 62·1 | First | — |
| | (e) Cotton (lint) | 9·48 | 72·5 | 13·1 | Third | China, USA |
| | (f) Tobaco leaves | 0·52 | 6·2 | 8·4 | Third | China, Brazil |
| 7. | **Livestock** (million heads) | | | | | |
| | (a) Cattle | 177 | 1357 | 13·01 | Second | Brazil |
| | (b) Buffalloes | 99 | 177 | 57·7 | First | — |
| | (c) Camels | 0·63 | 24·25 | 2·6 | Tenth | Somalia, Sudan, Ethiopia, Niger, Mauritania, Kenya, Mali, Pakistan, Chad |
| | (d) Sheep | 64 | 1087 | 5·9 | Third | China, Australia |
| | (e) Goats | 125 | 830 | 15·1 | Second | China |
| | (f) Chicken | 560 | 17863 | 3·1 | Fifth | China, USA, Indonesia, Brazil |
| 8. | **Animal Products** | | | | | |
| | (a) Total milk (000 t) | 106100 | 679207 | 15·6 | First | — |
| | (b) Total eggs (million) | 2670 | 63411 | 4·2 | Third | China, U.S.A. |
| | (c) Total Meat (000 t) | 6508 | 269149 | 2·4 | Fifth | China, USA, Brazil, Germany |
| 9. | **Implements** (000 numbers*) | | | | | |
| | Tractor-in-use | 2528 | 27632 | 9·1 | Second | USA |

* Figures related to 2006

*Source* : www.faostat.fao.org (FAO)

## *Appendix* 3

### Current and Projected Food Production V/s Demand in 2020 in India

(million tonnes)

| Year | Rice | Wheat | Coarse cereals | Pulses | Oilseeds | Milk (2010-11) |
|---|---|---|---|---|---|---|
| 2011-12 (Food Production) | 103·41 | 90·23 | 41·91 | 17·02 | 30·06 | 121·8 |
| 2020 (Demand) | 119 | 92 | 45·6 | 19·5 | | 116 |

*Source* : India Vision-2020.

## *Appendix* 4

### Agriculture Census in India (w.e.f. 1950 to 2005-06)

- **Earlier Agriculture Census**—Three Agriculture Census *viz.,* 1950, 1960 and 1970-71 were done at each 10 years interval.
- **Later on Agriculture Census**—Quinquennial (Q-at 5 years interval) by Deptt. of Agriculture and Co-operation w.e.f. 1970-71 (Ist); 1975-76 (IInd); 1980-81 (IIIrd); 1985-86 (IVth); 1990-91 (Vth); 2000-01 (VIIth) and last in 2005-06 (VIIIth Census).

### India Vision-2020 : Few Facts and Projections

- '**A Vision**' is not a Project or a Plan target. It is an articulation of the desired end results in broader terms. **—A.P.J. Abdul Kalam**
- 'National Population Policy-2000'—India's population projected—exceeds to 1·3 billion in the year 2020.
- By 2020, the people of India will be more numerous, better educated, healthier and more prosperous than at any time in our long history. **—Vision 2020**
- Targeted Annual '**GDP**' (Gross Domestic Product) Growth Rate of 8·5 to 9% over the next 20 years (say; up to 2020). Thus, in next 20 years, India would be on 4$^{th}$ place from the top in the year 2020 among 207 countries. Today, India's rank is around 11$^{th}$.

**—By World Development Report**

## *Appendix* 5

### Average Insecticide Intake through Food Products

(Quantity-mg/day/capita)

| S. No. | Nations | DDT | BHC |
|---|---|---|---|
| 1. | Australia | 20·0 | — |
| 2. | Canada | 10·8 | 2·5 |
| 3. | Germany | 149·0 | — |
| 4. | U.K. (England) | 12·0 | — |
| 5. | U.S.A. (America) | 6·5 | 1·1 |
| 6. | Yugoslavia | 98·0 | 62·0 |
| 7. | India | 238·1 | 124·4 |

## *Appendix* 6

# Long Stability Duration/Period of Some Important Pesticides

| S.No. | Pesticides | Long stability duration |
|---|---|---|
| 1. | Arsenical (Inorganic) | Uncertain |
| 2. | Chlorinated Hydrocarbon (DDT) | 2–5 years |
| 3. | Organo-Phosphate (Malathion) | 1–12 weaks |
| 4. | Carbamate | 1–2 years |
| 5. | Tri-azine (Atrazine/ Simazine) | 1–5 months |
| 6. | Phenoxy (2, 4-D; 2, 4, 5–T) | 1–6 months |
| 7. | Phenuron (Propanil) | 6–12 months |

## *Appendix* 7

(At current Price) (Rs. crore)

| Plan Outlay-Agriculture & Allied Sector/Irrigation & Flood Control | | | |
|---|---|---|---|
| | **Agriculture & Allied Sector** | **Irrigation & Flood Control** | **Total (%) (both)** |
| 8th Plan (1992-97) | 22467·2 (5·2%) | 32525·3 (7·5%) | 12·7% |
| 9th Plan (1997-2002) | 42462·0 (4·9%) | 55420·0 (6·5%) | 11·4% |
| 10th Plan (2002-07) | 58933·0 (3·9%) | 103315·0 (6·8%) | 10·6% |
| 10th Plan Expenditure of % of Outlay | 96·7% | 98·8% | 98·1% |

**(Source-11th Five Year Plan 2007-12)**

## *Appendix* 8

### Consumption of Chemical s in Indian Agriculture during 50 Years

(Quantity-million ton)

| S.No. | Item | 1950–51 | 1980–81 | 1990–91 | 2000–01 |
|---|---|---|---|---|---|
| 1. | Insecticides | 0·004 | 0·045 | 0·080 | 1·440 |
| 2. | Herbicides | — | 0·001 | 0·0048 | 0·0092 |
| 3. | Fertilizers | 0·066 | 5·51 | 12·66 | 17·60 |

## *Appendix* 9

# Agricultural Universities of India

- **SAU's (State Agricultural Universities)–53 (Established year)**

1. Acharya N.G. Ranga Agricultural Universty, Rajendranagar, Hyderabad (A.P.) – 1964
2. Assam Agricultural University, Jorhat (Assam) – 1969
3. Bidhan Chandra Krishi Vishwa Vidyalaya, Mohanpur, Nadia (W.B.) – 1974
4. Birsa Agricultural University, Ranchi (Jharkhand) – 1981
5. Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) – 1 March, 1975
6. Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana) – 1970
7. Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) – 1972
8. Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Distt. Solan (Himachal Pradesh) – 1985
9. Govind Ballabh Pant University of Agriculture & Technology, Pantnagar (Uttarakhand) – 17 Nov., 1960 (Ist)

10. Sardar Krushinagar, Agricultural University, Dantiwada (Gujarat) – 1972
11. Ch. Sarwan Kumar Krishi VishwaVidyalaya, Palampur (Himachal Pradesh) – 1978
12. Indira Gandhi Krishi Vishwa Vidyalaya, Raipur (Chhattisgarh) – 1987
13. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) —
14. Kerala Agricultural University, Vellanikera, Distt-Trichur(now Thrissur), Kerala – 1971
15. Dr. Balasahib Sawant Konkan Krishi Vidyapeeth, Dapoli (Maharashtra) – 1972
16. Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra) – 18 May, 1972
17. Marathwada Agricultural University, Parbhani (Maharashtra) – 1972
18. Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan) – 1 Nov. 1999
19. Narendra Dev University of Agriculture and Technology, Kumarganj, Faizabad (U.P.)—10 Oct., 1975
20. Orissa University of Agriculture and Technology, Bhubaneshwar (Orissa) – 1962
21. Punjab Agricultural University, Ludhiana (Punjab) – 1962
22. Swami Keshavanand Rajasthan Agricultural University, Bikaner (Raj.) – 1987
23. Rajendra Agricultural University, Samastipur, Pusa (Bihar) – 1970
24. Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (J & K) – 1982
25. Sher-e-Kashmir University of Agricultural Sciences and Technology, Gandhinagar, Jammu (J & K) – 1982
26. Tamil Nadu Agricultural University, Coimbatore (T.N.) – 1971
27. Tamil Nadu Veterinary & Animal Sciences University, Chennai (T.N.) – 1989
28. University of Agricultural Sciences, Bangalore (Karnataka) – 1899 (as college of Agric.)
29. University of Agricultural Sciences, Dharwad (Karnataka) – 1953 (Oct. 1)
30. West Bengal University of Animal and Fishery Sciences, Sarani, Kolkata (W.B.)—
31. Maharashtra Animal Sciences & Fisheries University, Nagpur (Maharashtra) – 2000
32. Karnataka Veterinary, A.H. & Fisheries Sciences University, Bidar (Karnataka)—
33. Shri Venkateswara Veterinary University, Tirupati (A.P.).—
34. Sardar Vallab Bhai Patel University of Agriculture & Technology, Modipuram, Meerut (U.P.) – 2 Oct., 2002
35. U.P. Pandit Deen Dayal Upadhyaya Pashuchiktsa Vigyan VishwaVidyalaya Evam Go Anusandhan Sansthan, Mathura (U.P.)—
36. Uttar Banga VishwaVidyalaya, Pundibari, Cooch Bihar (W.B.) – 1 Feb., 2001
37. Anand Agric. University, Anand (Gujarat)) – 1938
38. Junagarh Agric. University, Junagarh (Gujarat) – 1972
39. Navsari Agric. University, Navasari (Gujarat) – 1972
40. Guru Angad Dev Veterinary & Animal Sciences University, PAU campus, Ludhiana (Punjab)—
41. University of Horticulture & Forestry, Ranichauri, Tehri Garhwal (Uttarakhand)—
42. Rajmata Vijayraje Sindhia Krishi Vishwa Vidhyalaya (RVSKVV), Gwalior (M.P.) – 2008
43. Bihar Agricultural University Sabour, Bhagalpur Distt. (Bihar)
44. Dr. Y.S.R. Horticultural University Venkataramannagudem.
45. Kerala University of Animal Science Thirvanthapuram (Kerala)
46. Kerala University of Fisheries and Ocean Studies, Papangad (Kerala)
47. Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar (Haryana)
48. Madhya Pradesh Pashu Chikitsa Vigyan Vishwa Vidyalaya, Jabalpur (M.P.)
49. Manyavar Shri Kanshiram Ji University of Agriculture and Technology, Banda (U.P.)—(2 March, 2010)
50. Rajasthan University of Veterinary and Animal Sciences, Bikaner (Rajasthan)
51. University of Agricultural Sciences, Raichur (Karnataka)
52. University of Horticultural Sciences Bagalkot (Karnataka)
53. Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri Garhwal, Uttarakhand

- **Central Agril. University—(1)**

1. Central Agricultural University, Imphal (Manipur)–established 26 January in 1993

- **Deemed to be Universities—(5)**

1. Indian Agricultural Research Institute (IARI), Pusa Campus, New Delhi – 1936
2. Indian Veterinary Research Institute, Izatnagar (Uttar Pradesh)—
3. National Dairy Research Institute, Karnal (Haryana)—
4. Central Institute of Fisheries Education, Jaiprakash Road, Versova, Mumbai (Maharashtra) —
5. Sam Higginbottom Institute of Agriculture, Technology and Sciences (SHIATS) Allahabad (U.P.)-est. 1910 as old name Allahabad Agricultural Institute (AAI).

- **Central Universities (Related to Agriculture Faculty/Institutes)—(4)**

1. AMU, Aligarh (U.P.)—
2. BHU, Varanasi (U.P.)—1916
3. Visva Bharati, Sriniketan (W.B.)—
4. School of Agricultural Sciences & Rural Development Nagaland University, Medzifema (Nagaland)—

## *Appendix* 10

# ICAR (Indian Council of Agricultural Research) Awards for Promotion to Agricultural Institutes/Scientists/Women/Farmers 2010

**Yearly**

(i) Sardar Patel Outstanding Institution Award (Earlier ICAR Best Institution Award (1 – SAU/CAU/DUS 1 – ICAR Institute, Total = 3)

(ii) Jawaharlal Nehru Awards for Outstanding Post-graduate Agricultural Research (related fields—Crop Improvement, Bio-technology, Plant Protection, Natural Resource Management, Horticulture, Engineering & Technology, Animal Sciences Fisheries & Social Science) (14)

(iii) Jagjivan Ram Kisan Puruskar—Crop Protection (8)

(iv) N.G. Ranga Farmer Award for Diversified Agriculture (1)

(v) Punjabrao Deshmukh Women Scientist Award (2)

(vi) Vasantrao Naik Award for Research Applications in Dryland Agriculture (1)

(vii) Chaudhary Charan Singh Award for Excellence in Journalism in Agricultural Research & Development (1)

(viii) Chaudhary Devi Lal Outstanding AICRP Project Award (1)

(ix) Dr. Rajendra Prasad Puruskar for Technical Books in Hindi in Agriculture and Allied sciences (3)

(x) **ICAR** Norman E. Borlaug Award (1)

(xi) National & Zonal Krishi Vigyan Kendra Awards (7)

(xii) Bharat Ratna Dr. C. Subramaniam Award for outstanding Teachers (3)

**Biennium**

(i) Lal Bahadur Shastri Young Scientist Awards for the Biennium (related fields—Crop Sciences, Soil Science, Agronomy & Agro-forestry, Horticulture Engineering & Animal Sciences, Social Sciences & Home Science. (10)

(ii) Hari Om Ashram Trust Awards for the Biennium (related fields—Crop Science, Horticulture, Natural Resource Management & Animal Health) (4)

(iii) Rafi Ahmed Kidwai Awards for the Biennium (related fields—Crop Improvement & Crop Protection, Horticulture, Natural Resource Management, Engineering & Technology, Animal Science and Fisheries & Aquatic Life Sciences. (8)

(iv) Swami Sahajanand Saraswati Extension Scientist/Worker Awards for the Biennium (related fields—Crop Production, Livestock Production), Natural Resource Management and Home Science. (5)

(v) Fakhruddin Ali Ahmed Award for Outstanding Research in Tribal Farming System (2).

## *Appendix* 11

# About–ICAR (Indian Council of Agricultural Research)

- **Old Name—**Imperial Council of Agricultural Research; Autonomous Body; Societies Registration Act 1860, No. 21; 16 July, 1929 Estbd., New Delhi on the recommendation of Royal Commission of Agriculture. It was reorganised twice, in 1965 & 1973, H.Q. Krishi Bhavan New Delhi & other building at Pusa compus Krishi Anusandhan Bhavans I & II & NASC New Delhi.
- **Re-named—**After Independence (in 1947), Indian Council of Agricultural Research (ICAR), New Delhi, under Ministry of Agriculture, Govt. of India.
- **Organizations—**

  **—National Institutes-5—**IARI, New Delhi; IVRI, Izatnagar; NDRI, Karnal and CIFE (Central Institute of Fisheries Education), Mumbai (Maharashtra); NAARM–National Academy of Agricultural Research & Management, Hyderabad (A.P.); Agricultural Sciences-43 and (Total-48 Institutes).

  **—National Bureaux-5—**Agricultural Science-3; NBPGR, New Delhi & NBSS & LUP, Nagpur and NBAIM. *i.e.*, of Agriculturally Important Micro-organism, New Delhi and **Animal Sciences (2)**– NBAGR *i.e.*, Animal Genetic Resources, Karnal; NBFGR, *i.e.*, Fish Genetic Resources, Lucknow.

  **—Project Directorates-12—**(Agricultural Science-8 and Animal Sciences-4).

  **—National Research Centres-32—**(Agricultural Sciences-23; Animal Sciences & Fisheries-7 and General-2) but w.e.f. 1 April, 2009—**9** NRC's have been upgraded to Directorate *viz*. (i) NRC—Weed Science, Jabalpur; (ii) NRC—R & M, Bharatpur; (iii) NRC—G.Nut Junagarh; (iv) NRC—Soyabean, Indore; (v) NRC—Cashew Puttur (Karnataka); (vi) NRC—Mushroom, Solan (H.P.); (vii) NRC—Onion & Garlic, Pune; (viii) NRC for Women in Agric., Bhubaneshwar and (ix) NRC—Cold Water Fisheries Nainital (Uttaranchal).

  **—All India Co-ordinated Research Projects-76—**Crop Sciences-30; Horticulture-13; NRM (Natural Resource Management)-12; Engineering & Technology-6; Animal Sciences & Fisheries-14 and Education-1.

  **—Agricultural Universities—**SAU's–42; Central Agric. Univ.-1 (Imphal, Manipur), Deemed to be University-5; and Central Institutes related to Agriculture–4; AMU, Aligarh; BHU, Varanasi Visva Bharati, Sriniketan (W.B.) and School of Agricultural Sciences & Rural Development, Nagaland University Medziphema (Nagaland)
- **About—**IARI (Indian Agricultural Research Institute)

  —Originally est. at Pusa (Bihar) in 1905 at 'Naulakha' farm (Samastipur dis.) having 16000 acre land – Fully financed by American Philanthropist–Mr. Henry Phipps and foundation stone by the then vicesory & Governor General of India–Mr. Baron curzon of kedleston in 1905. Due to damaged building by Earthquake, it was shifted & started at New Delhi in 1936. Deemed-to be–University in 1956 for MSC & PhD. Agric. courses and UGC Act 1956. Ist Dean of IARI New Delhi–New Pusa was R.W. cummings.
- **First Agricultural Colleges established in India in 1905**—Sabour (Bihar), Kanpur (U.P.), Nagpur (Maharashtra), Pune (Maharashtra), Coimbatore (Tamil Nadu) and Layalpur (now in Pakistan, earlier in Punjab).

## *Appendix* 12

# Indian Societies/Association Related to Agriculture (Estb. Year)

- **Indian Society of Agronomy** (ISA, IARI, New Delhi, 1955); Agil. Sciences (ISAS New Delhi, 1979); Agril. Chemistry (ISAC, Allahabad, 1968); Cotton Improvement (ISCI, Bombay, 1975); Coastal Agril. Research (ISCAS, Canning Town, West Bengal, 1982–83); Genetics & Plant Breeding (ISGPB, New Delhi, 1941); Mycology and Plant Pathology (ISMPP, Udaipur, 1971); Plant Genetic Resources (ISPGR, New Delhi, 1987), Plant Physiology (ISPP, New Delhi, 1958); Pulse Research & Development (ISPRD, Kanpur, 1987); Soil Science (ISSS, New Delhi, 1934); Weed Science (ISWS, Hisar, 1968).
- Indian Virological Society, Hisar (1948); Indian Water Resource Society, Roorkee (1980); Horticulture Society of India, New Delhi (1942); Sugarcane Technologists Assoc. of India (1925); Arid Zone Resource Association of India, Jodhpur (1962); Agricultural Society of India, Kolkata (1957-58); Plant Protection Association of India, Hyderabad (1972).

*Appendix* **13**

# Conversion Factor/Ratio between Agricultural Raw Material and Processed Products

| S.No. | Raw Material | Processed Products |
|---|---|---|
| 1. | **Groundnut** | |
| | —Kernels to nuts in shell | 70% |
| | —Oil to nuts in shell | 28% |
| | —Oil to kernels crushed | 40% |
| | —Cake to kernels crushed | 60% |
| 2. | **Sugarcane** | |
| | —Gur from cane crushed | 10% |
| | —Crystal sugar from gur refined (Gur refineries) | 62·4% |
| | —Crystal sugar from cane crushed (cane factories) | 9·97% (or 10%) |
| | —Molasses from cane crushed | 3·5% |
| | —Cane thrash from cane harvested | 10·0% |
| | —Khandsari sugar from gur refined | 37·5% |
| 3. | **Soybean Seed** | |
| | —Oil to soybean seed crushed | 18·0% |
| | —Meal to soybean seed crushed | 72·0% |
| 4. | **Cotton** | |
| | —Oil to seeds crushed | 14 to 18% |
| | —Cake to seeds crushed | 82 to 86% |
| | —Lint to seed cotton | 33% (1/3) |
| | —Cotton seed to seed cotton | 66–67% (2/3) |
| | —1 candy | 355 kg |
| | —1 bale | 170 kg each |
| 5. | **Rice** | |
| | —Rice (cleaned) production | 2/3 of paddy production |
| 6. | **Castor seed** | |
| | —Oil to seed crushed | 37% |
| | —Cake to seeds crushed | 63% |
| 7. | **Linseed** | |
| | —Oil to seeds crushed | 33% |
| | —Cake to seeds crushed | 67% |

| | | |
|---|---|---|
| 8. | **Sesamum** | |
| | —Oil to seeds crushed | 40% |
| | —Cake to seeds crushed | 60% |
| 9. | **Rapeseed and Mustard** | |
| | —Oil to seeds crushed | 33% |
| | —Cake to seeds crushed | 67% |
| 10. | **Coconut** | |
| | —Copra to nuts | One tonne of Copra = 6773 nuts |
| | —Oil to Copra crushed | 62% |
| | —Cake to Copra crushed | 38% |
| 11. | **Niger seed** | |
| | —Oil to seeds crushed | 28% |
| | —Cake to seeds crushed | 72% |
| 12. | **Kardi seed** | |
| | —Oil to seeds crushed | 40% |
| | —Cake to seeds crushed | 60% |
| 13. | **Mahua seed** | |
| | —Oil to seeds crushed | 36% |
| | —Cake to seeds crushed | 34% |
| 14. | **Neem seed** | |
| | —Oil to Kernel crushed | 45–50% |
| | —Cake to Kernel crushed | 50–55% |
| 15. | **Jute** | |
| | —100 yards of hessian | 54 lb of raw jute |
| | —4,148 yards of hessian | 1 ton of raw jute |
| | | 5·55 bales of raw jute (of 180 kg each) |
| | —1 tonne of sacking | 1·11 tonnes of raw jute |
| | | 6·17 bales of raw jute (of 180 kg each) |
| | —1 tonne of hessian, sacking each …… | 1·05 tonnes of raw jute |
| | | 5·85 bales of raw jute (of 180 kg each) |
| 16. | **Lac** | |
| | —Seed lac | –66% of stick lac |
| | —Shell lac | –57·4% of stick lac/or 87% of seed lac |
| 17. | **Cashew nuts** | |
| | —Cashew Kernels | 25% of Cashew nuts |
| 18. | **Butter & Ghee** | |
| | —Butter from mixed milk | 6·9% |
| | —Ghee from mixed milk | 5·5% |

## *Appendix* 14

# Plants Indicating Deficiencies of Plant Nutrients

| Primary/Manurial Nutrients | | Secondary Nutrients | | Micro-nutrients | |
|---|---|---|---|---|---|
| **Plant Nutrients** | **Indicator Plants** | **Plant Nutrients** | **Indicator Plants** | **Plant Nutrients** | **Indicator Plants** |
| (1) N | Maize, Apple, Citrus, Peach | (1) Ca | Berseem | (1) Bo | Berseem, Turnip, Apple, Pear |
| (2) P | Tomato, Barley, Maize | (2) Mg | Potato, Cauli-flower, Apple | (2) Cu | Citrus, Maize, Toba-cco, Barley, Tomato, Onion |
| (3) K | Cereal crops, Potato, Lucerne, Bean, Tobacco, Carrot, Sugarcane | (3) S | Berseem, Barley, Soybean, Tobacco | (3) Fe | Cauliflower, Citrus, Banana |
| | | | | (4) Mn | Apple, Cherry, Citrus |
| | | | | (5) Mo | Tomato, Palak, Cauli-flower, Sugarbeet |
| | | | | (6) Zn | Citrus, Tomato, Oat |
| | | | | (7) Cl | Tomato, Maize, Bean |

## *Appendix* 14A

| Plant/Soil Nutrients Researchers/Originated Year | | | |
|---|---|---|---|
| ● | Nitrogen—Daniel Rutherford (1772) | ● | Bromine—Balard (1826) |
| ● | Phosphorus—Brand (1674) | ● | Manganese (Mn)—Gaan (1774) |
| ● | Ammonia—F.G. Haber (1908) | ● | Hydrogen—Berzellius & Others (1803) |
| ● | Oxygen—J. Priestley (1774) | ● | Nickel—A. Cronsted (1751) |
| ● | Aluminium—H.C. Oersted (1827) | ● | Active Nitrogen—R.J. Strut (1910) |
| ● | Magnesium—S. Humphrey Davy (1755) | ● | 16 Essential plant nutrients by Arnone California (UAS) scientist (1954)—CHO (3), NPK (3), Ca MgS (3), Fe, Mn, BO, ZN Cu Cl Mo (7-micro-nutrients). |
| ● | Ozone—Crispian Sconban (1839) | | |
| ● | Silicon—John Berzellius (1824) | | |
| ● | Vanadium—Safstrome (1830) | | |
| ● | Chromium—Vakvalin (1797) | | |
| ● | Chlorine—Shile (1774) | | |
| ● | Iodine—B. Cortosis (1811) | | |

## *Appendix* 15

# Optimum Concentration of Plant Micro-nutrients for Foliar Spray

| S. No. | Nutrient | Compound/ Chemical | Soil Application (kg/ha)* | Foliar Spray |
|---|---|---|---|---|
| 1. | Zinc (Zn) | $ZnSO_4.7H_2O$ | 25–50 | 0·5% $ZnSO_4$ + 0·25% lime |
| 2. | Iron (Fe) | $FeSO_4.7H_2O$ | 20–40 | 0·4% $FeSO_4$ + 0·2% lime |
| 3. | Copper (Cu) | $CuSO_4.5H_2O$ | 10–50 | 0·1% $CuSO_4$ + 0·05% lime |
| 4. | Manganese (Mn) | $MnSO_4.3H_2O$ | 20–40 | 0·6% $MnSO_4$ + 0·03% lime |
| 5. | Boron (Bo) | — | 5–20 | 0·2% Borax |
| 6. | Molybdenum (Mo) | Sodium Molybdate | 0·5 | 0·5% Sodium Molybdate |

* Quantity/rate of soil application depends upon soil condition and type.

## *Appendix* 16

## Average Nitrogen Fixed by Different $N_2$ Fixing Systems in Agriculture

| S.No. | $N_2$ fixing system | $N_2$ fixing (kg N/ha) |
|---|---|---|
| 1. | **Free-living/Associative** | |
| | (i) Rice-BGA (Blue Green Algae) | 10–80 per crop |
| | (ii) Rice-Bacterial Association | 10–30 per crop |
| | (iii) Sugarcane-Bacterial Association | 20–160 per crop |
| 2. | **Symbiotic** | |
| | (i) Rice-Azolla | 20–100 per crop |
| | (ii) Legume-Rhizobium | |
| | —Leucaena leucocephala | 100–300 per crop |
| | —Soybean | 20–237 per crop |
| | —Trifolium repens | 13–238 per crop |
| | —Sesbania rostrata | 320–360 per crop (av. 180) |
| 3. | **None-legume** | |
| | —Frankia casuarina sps | 40–60 per year |

## *Appendix* 17

## Acid or Base Equivalent of Nitrogenous Fertilizers

| S. No. | Fertilizer | N Content (%) | Acid or Base Equivalent for per 50 kg of N @ $CaCO_3$ | |
|---|---|---|---|---|
| | | | Acidic | Basic |
| 1. | Ammonium Sulphate | 20·6 | 265 | — |
| 2. | Ammonium Nitrate | 33 | 90 | — |
| 3. | Calcium Ammonium Nitrate | 20·5 | 0 | 0 |
| 4. | Ammonium Sulphate Nitrate | 26 | 165 | — |
| 5. | Urea | 46 | 150 | — |
| 6. | Ammonium Chloride | 25 | 156 | — |
| 7. | Anhydrous Ammonia | 82 | 90 | — |
| 8. | Sodium Nitrate | 16 | — | 90 |
| 9. | Calcium Cynamide | 21 | — | 150 |
| 10. | Calcium Nitrate | 15 | — | 68 |

## *Appendix* 18

### Conversion Factor

- $NO_3$ = N × 4·54
- N(%) = $NO_3$ × 0·22
- P = $P_2O_5$ × 0·44
- $P_2O_5$ = P × 2·29
- K = $K_2O$ × 0·83
- $K_2O$ = K × 1·20
- Ca = CaO × 0·71
- CaO = Ca × 1·40
- Mg = MgO × 0·61
- MgO = Mg × 1·63
- Organic Matter (OM) = Organic Carbon (O.C.) × 1·724
  (Since, 58% O.C. found in 100 % O.M.; say; O.M. contains 58% O.C.)
- 2000 ppm solution means 0·2% or 2g/litre water for spray.

## *Appendix* 19

# Measurements and Units

### (A) Metric Measures (with approximate non-metric equivalents)

| Measures | Metric | Non-metric |
|---|---|---|
| Length | 10 millimetres (mm) = 1 centimetre (cm) | = 0·394 inch |
| | 100 centimetres = 1 metre (m) | = 39·4 inches/ or 1·094 yards |
| | 1000 metres = kilometre (km) | = 0·6214 mile |
| Area | 100 square metres ($m^2$) = 1 are (a) | = 0·025 acre |
| | 100 are = 1 hectare (ha) | = 2·471 acres |
| | 100 hectares = 1 square kilometre ($km^2$) | = 0·386 square mile |
| Weight | 1000 milligrams (mg) = 1 gram (g) | = 15·43 grains |
| | 1000 grams = 1 kilogram (kg) | = 2·205 pounds |
| | 1000 kilograms = 1 tonne | = 19·688 hundred weight |
| Capacity | 10 millilitres (ml) = 1 centilitre | = 0·018 pint (0·021 US pint) |
| | 100 centilitres (cl) = 1 litre (l) | = 1·76 pints (2·1 US pints) |
| | 10 litres = 1 decalitre (dal) | = 22 gallon (263 US gallons) |

### (B) SI Units

| Item | Physical Quantity | Name | Symbol |
|---|---|---|---|
| **Base Units** | Length | Metre | m |
| | Mass | Kilogram | kg |
| | Time | Second | s |
| | Electric current | Ampere | A |
| | Thermodynamic temperature | Kelvin | K |
| | Luminous intensity | Candela | Cd |
| | Amount of substance | Mole | mol |
| **Supplementary Units** | Plane angle | Radian | rad |
| | Solid angle | Steradian | sr |

## *Appendix* 20

# Temperature Changes

### Temperatures : Celsius (Centigrade) and Fahrenheit

| Celsius (°C) | Fahrenheit (°F) |
|---|---|
| –17·8° | 0° |
| –10° | 14° |
| 0° | 32° |
| 10° | 50° |
| 20° | 68° |
| 30° | 86° |
| 40° | 104° |
| 50° | 122° |
| 60° | 140° |
| 70° | 158° |
| 80° | 176° |
| 90° | 194° |
| 100° | 212° |

**Note :** (i) To convert Celsius into Fahrenheit : multiply by 9, divide by 5, and add 32.
**Example :** 10°C × 9 = 90 ÷ 5 = 18 + 32 = 50°F

(ii) To convert Fahrenheit into Celsius : subtract 32, multiply by 5, and divide by 9.
**Example :** 86°F – 32 = 54 × 5 = 270 ÷ 9 = 30°C

(iii) **Formula** : $\frac{C}{5} = \frac{F - 32}{9}$

## *Appendix* 21

# Production Share (%) and first three ranks of Important Fruits and Vegetables in India

| S.No. | Fruits | Production Share (%) | Rank | S.No. | Vegetables | Production Share (%) | Rank |
|---|---|---|---|---|---|---|---|
| 1. | Banana | 33·0 | I | 1. | Potato | 27·8 | I |
| 2. | Mango | 23·3 | II | 2. | Brinjal | 9·4 | II |
| 3. | Citrus Group | 11·1 | III | 3. | Tomato | 8·4 | III |
| 4. | Papaya | 6·0 | — | 4. | Tapioca | 7·4 | — |
| 5. | Guava | 4·0 | — | 5. | Cabbage | 6·4 | — |
| 6. | Grapes | 2·8 | — | 6. | Onion | 5·9 | — |
| 7. | Apple | 2·7 | — | 7. | Cauliflower | 5·5 | — |
| 8. | Pineapple | 2·7 | — | 8. | Lady's Finger (Okra) | 3·8 | — |
| 9. | Sapota | 1·4 | — | 9. | Peas | 2·3 | — |
| 10. | Litchi | 0·8 | — | 10. | Sweet-Potato | 1·3 | — |
| 11. | Others | 12·0 | — | 11. | Others | 22·0 | — |

*Source* : Annual Report 2010-11, Agric. & Co-op. Deptt. Agric. Ministry (Govt. of India).

**Notes—**

1. In total production of the world, India's share of mango production-52·2% and of Banana-11%
2. The productivity of grape of India is maximum in the world.
3. India's share in world, for vegetables is 13·28% and for fruits 10%.
4. India is the largest producer of mango, banana, sapota and citrus in the world.
5. India ranks II (next to China) in area & production of vegetables; ranking first in production of cauliflower; II in onion and III rank in cabbage in the world.

## *Appendix* 22

# Horticulture Related—Flowers & Trees Convey Some Feelings

| Flowers | Feelings | Trees | Feelings |
|---|---|---|---|
| Alyssum | Worth Beyound Beauty | Acacia Tree | Permanence |
| Anemone | Forsaken | Apricot | Fruitfulness |
| Blue Bell | Constancy | Aspidistra | Strength |
| Basil | Hatred | Bamboo | Youth, Perseverance and good luck |
| Candituft | Indifference | Begonia | Perfect Yin/Yang Balance |
| Carnation | Refusal | Cherry | Fruitfulness |
| Chrysanthemum (red) | Love | Camellia | Evergreen |
| Chrysanthemum (white) | Truth | Chrysanthemum | Endurance and long life |
| Daffodil | Regard | Cypress | Nobility |
| Forget-me-not | True love | Delphinium | Consolidation |
| Geranium (dark) | Melancholy | Flowers | Wealth |
| Golden Rose | Precaution | Gardenia | Strength |
| Gladiolus | Strength of character | Hibiscus | Abundance |
| Hibiscus | Delicate Beauty | Hydrangea | Achievement |
| Iris | Message | Jasmine | Friendship |
| Jasmine | Amiability | Juniper | Tolerance |
| Lavender | Distrust | Lilies | Profusion |
| Lilac (purple) | First Love | Lotus | Determination |
| Lilac (white) | Innocence | Magnolia | Fragrance |
| Morning glory | Affection | Old Man | Longevity |
| Narcissus | Egotism | Orange | Wealth |
| Pansy | Thoughts | Orchid | Patience and endurance |
| Peony | Bashfulness | Peach | Friendship |
| Primrose | Early Youth | Pear | Long life |
| Poppy | Fantastic Extravagance | Peony | Wealth |
| Snowdrop | Hope | Pine Tree | Long life |
| Sweat Pea | Departure | Plum | Beauty and youth |
| Sweet William | Gallantry | Pomegranate | Fertility Red |
| Tulip (red) | Declaration of love | Happiness | Prosperity |
| Tulip (yellow) | Hopeless love | Rhododendron | Fragility |
| Violet (blue) | Faithfulness | Rose | Beauty |
| Violet (yellow) | Joy | Water lily | Fortitude |
| Verbena (white) | Pure and Guileless | Willow | Grace |
| Xanthium | Rudeness | Wisteria | Beauty |
| Zinnia | Thoughts of absent friends | | |

## *Appendix* 23

# Terms Used for Animals

| Animal | Male | Female | Young | Group | Related Adjective | Home/or Managerie |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Ass/or Donkey | Jack, Jackass, Dicky | Jenny | Foal, Colt (Male), Filly (Female) | Herd, Drove | Asinine | — |
| Badger (like a bear) | Boar | Sow | Cub | Cete | Meline | Sett, Set |

| | | | | | | |
|---|---|---|---|---|---|---|
| Bee/or Honey bee | — | — | — | Sw arn | Apian | Apiary, Hive (comb) |
| Bear | — | — | Cub | Sloth | Ursine | — |
| Bird | Cock | Hen | Chick, Fledling | Flock | Avian | Nest, Roost, Aviary |
| Cat | Tomb, Gibcat (usually castrated) | Queen, Tabby | Kitten | Litter, Kindle (of Kittens) | Feline | Cattery, lair or Den (Wild cats) |
| Cattle | Bull, Ox (castrated) | Cow means (Vacca–Latin word) | Calf, Stirk, Bullock (Male), Heifer (female), Steer (castrated male) | Herd, Drove, Drift, Team or Yoke (Oxen) | Bovine, Taurine (Bulbs) | Byre |
| Chicken | — | — | Chick | Broad, Clutch | — | — |
| Deer | Buck, Stag, Hart | Doe, Hind | Fawn, Calf, Kid, Pricket or Brocket (Male) | Herd | Cervine | — |
| Dog | Dog, Hound | Bitch | Pup, Puppy, Whelp | Pack, Hennel (of hounds); Litter (of pups) | Canine | Kennel |
| Elephant | Bull | Cow | Calf | Herd | Elephantine | — |
| Fish | — | — | Fry | Shoal | piscine | — |
| Fox | Dog | Vixen | Cub | Shulk | Vulpine | Earth, Lair |
| Frog | — | — | Tadpole | — | Ranne, Anauran, Batrachian, Salientian | — |
| Goat | Billy, Buck | Nanny, Doe | Kid | Flock, Herd, Tribe | Caprine, Hircine | — |
| Goose | Gander | — | Gosling | Gaggle, Shein | Anserine | — |
| Hare (Wild rabbit) | Buck, Jack | Doe, Puss | Leveret | Down, Husk, Trip | Leporine | Form |
| Horse | Stallion, Horse, Sire, Gedling (castrated) | Mare, Dam | Foal, Calt (Male), Filly (Female) | Herd, Team, Stable, Troop, Rag or Rate (Of colts) | Equine | Stable, Paddock, Stall, Stud |
| Kangaroo | Buck, Boomer | Doe, Blue Flier | Joey | Troop, Herd, Mob | Maropine | — |
| Leopard | Leopard | Leopardess | Cub | Leap | Pardine | — |
| Lion | Lion | Lioness | Cub | Pride | Leonine | Den |
| Monkey | — | — | — | Troop, Tribe | Simian | — |
| Pig/Boar | Boar, Hog (castrated) | Sow, Gilt | Piglet, Pigling, Squeaker, Shoat, Gilt (female) | Herd, Sounder (Of wild pigs), Farrow (of piglets) | Porcine, suilline | Pen, Sty |
| Rabbit | Buck | Doe | Kitten | — | Oryctolagine | Warren, urrow, Coneygarth (Historical) |
| Rat | Buck | Doe | Nestling | — | Murine | — |
| Sheep | Ram, Tup, Wether (castrated) | Ewe | Lamb, Teg, Hog | Flock, Trip, Drove, herd | Ovine | Fold |
| Snake | — | — | — | — | Anguine, Ophidian | Den, Nest |

## *Appendix* 24

| Livestock Population (in million) | | | | |
|---|---|---|---|---|
| **S. No.** | **Species** | **Livestock Census** | | **2007 (18th Census)** |
| | | **1997** (16th Census) | **2003** (17th Census) | |
| 1. | Cattle | 198·9 | 185·2 | 199·0 |
| 2. | Buffalo | 89·9 | 97·9 | 105·3 |
| 3. | Yaks | 0·06 | 0·07 | 0·08 |
| 4. | Mithuns | 0·18 | 0·28 | 0·26 |
| | **Total Bovines** | **289·0** | **283·4** | **304·8** |
| 5. | Sheep | 57·5 | 61·5 | 71·6 |
| 6. | Goat | 122·7 | 124·4 | 140·5 |
| 7. | Pigs | 13·3 | 13·5 | 11·1 |
| 8. | Other Livestock | 2·8 | 2·2 | 1·7 |
| | **Total Livestock** | **485·4** | **485·0** | **529·7** |
| 9. | Poultry | 347·1 | 489·0 | 648·9 |
| | (First Livestock Census was conducted during 1919-1920 and since then at quinquennially *i.e.* 5 years interval. The 18th census was completed in 2007. The census is conducted as a 100% centrally sponsored scheme) | | | |

## *Appendix* 25

### (i) Agro-climatic & Agro-Eco Regions

**(Total Agro-climatic Zones-15 and Agro-climatic Sub-Zones-72)**

| Agro-climatic zones (15) | Agro-climatic sub-zones (72) | Related State |
|---|---|---|
| 1 | 3 | J & K, H.P. & U.P. |
| 2 | 5 | Assam, Sikkim, W. Bengal and all N.E. States |
| 3 | 4 | W. Bengal |
| 4 | 6 | U.P. & Bihar |
| 5 | 3 | U.P. |
| 6 | 3 | Punjab, Haryana, Delhi and Rajasthan |
| 7 | 5 | Maharashtra, U.P., Orissa and W. Bengal |
| 8 | 14 | M.P., Rajasthan and U.P. |
| 9 | 4 | Maharashtra, M.P. and Rajasthan |
| 10 | 6 | A.P., Karnataka and T. Nadu |
| 11 | 6 | Orissa, A.P., T.Nadu and Pondicherry |
| 12 | 4 | T. Nadu, Kerala, Goa, Karnataka and Maharashtra |
| 13 | 7 | Gujarat |
| 14 | — | Rajasthan |
| 15 | 2 | Andman-Nicobar, Lakshadweep |

(ii) **Agro-Ecological Regions/Zones (AER/AEZ) (20) and Agro-Eco Sub Region (AESR) (60) of India**

(iii) **Agro-climatic Zones/Regions of Uttar Pradesh (9)**

| Agro-climatic Zone (9) | Related Zone/Area |
|---|---|
| 1 | Tarai (bottom of Himalaya-Rampur, Pilibhit, Bijnore area) |
| 2 | Western Plains (Meerut Region) |
| 3 | Mid-West-Plains (Moradabad and Bareilly Zone/Region) |
| 4 | South-West-Plains (Agra Region) |
| 5 | Mid (Central) Plains (Kanpur, Lucknow Zone/Region) |
| 6 | Bundelkhand (Jhansi, Chitrakoot Dham Region) |
| 7 | North-East Plains (Gorakhpur Region) |
| 8 | Eastern Plains (Faizabad, Azamgarh and Varanasi Region) |
| 9 | Vindhya (Vindhyachal Region) |

## *Appendix* 26

# Proverbs Related to Agriculture

**(A) About Manures**

- "Rich in manure, rich in fruit" —Atharva Veda Samhita, CIRCA 350 B.C.
- "No fodder, no cattle; no cattle, no manure; no manure, no crop." —Ancient Tamil Proverb
- "A field without manure is as worthless as a cow without a calf." —Ancient Telugu Proverb
- "Without manure, rice plants grow but do not bear a crop." —Parasara, Circa, 1300 B.C.

**(B) About Sowing and Soils**

- "He should be acquainted with the manner of sowing seeds and with the good and bad qualities of the soil." —Manu Smriti, CIRCA The time of Christ
- "They manured their fields with a white chalk which they dug out of the ground." —Varra, 116-28 B.C.
- No one thrives by tilling sandy soil, and no one is ruined by ploughing clay." —Ancient Tamil Proverb
- "Black soil for gingelly (Sesamum/Til) and stony oil for gram' —Ancient Tamil Proberb

**(C) About Water Conservation**

- "Ridges made of earth should at first be constructed for the purpose of dividing the fields and for conserving water in the fields; and then the seed should be sowing." —Khana (600 A.D.)

**(D) About Soil and Plant Growth**

- "The crops on a field diminish or increase in exact proportion to the mineral substances conveyed to them in manure (fertilizer)." —Justus Von Liebig, 1803-1873

**(E) About Soil Water—**

- "Though you allow shade, allow no water to stand." —Ancient Tamil Proverb

**(F) About Weathering and Soil Formation—**

- "A manure soil is one that has assumed the profile features characteristic of the predominant soils on the smooth uplands within the general climatic and botanic region in which it is found." —C.F. Marbut, 1926
- "A geological deposit, the glacial till, the sandy deposits of the sand plains, the lake-laid or marine clays, sands, silts, and gravels, the residual earth resulting from lock decay constitute soil materials or parent materials of soils." —C. F. Marbut, 1923

**(G) About Soil Survey**

- Soil surveys have created a new branch of soil science—Soil Anatomy. —C.F. Marbut, 1921

**(H) About Soil Properties**

- "No one thrives by tilling sandy soil, and no one is ruined by ploughing day."
—Ancient Tamil Proverb

**(I) About Acid Soils**

- "They manured their fields with a white chalk which they dug out of the ground."
—Varrow, 116-28 B.C.

**(J) About Saline and Alkali Soils**

- "He should be acquainted with the manner of sowing seeds and with the good and bad qualities of the soil." —Manu Smriti, Circa the Time of Christ

**(K) About Biological Properties of Soil**

- "All dead things-rotting corpse or stinking garbage returned to earth are transformed into wholesome things that nourish life. Such is the alchemy of mother earth."
—Ramayana (As interpreted by C. Rajagopalachari)
- The source of nitrogen in the soil was an early stumbling block to the balance-sheet theory of soil-plant relationship. The question was cleared-up in the 1980's with the discovery that Rhizobium organisms grow in the nodules on the roots of leguminous plants and fix nitrogen from the air into forms that plants can use. —Charles E. Kellogg

**(L) About Environment**

- We have to see environment and development together. If we are worried about environment in the future, we have to worry about poverty today. You can't rubbish one, at the cost of other. —Prof. Amartya Sen (Nobel Laureate)

**(M) About India**

- "India is the cradle of the human race, the birth place of human speech, the mother of history, the grandmother of legend and the greate grandmother of tradition. Our most valuable and most instructive materials in the history of man are treasured up in India only." —Mark Twain

**(N) About Farmer**

- "Grain Giver (Annadata) is Farmer" say; "To serve the farmer, is to serve the God."

## *Appendix* 27

# Electronic Publication of Agricultural Research Information Centre—ICAR New Delhi

**(A) CDs on 'ITK'**

- Inventory of Indigenous (Inherited) Technical Knowledge (ITK) in Agriculture-Document 1.
- Inventory of Indigenous Technical Knowledge (ITK) in Agriculture-Document-2.
- Inventory of Indigenous Technical Knowledge (ITK) in Agriculture-Document 2 (Supplement 1).
- Validation of Indigenous Technical Knowledge (ITK) in Agriculture-Document 3.
- **NARD-CD** (2002-03)—Covers Abstracts of Articles published in Agriculture Periodicals in India.
- Indian Farming CD (1995-2000)—Covers the full text articles published during 1995-2000.
- Indian Horticulture CD (1991-2000)—Covers the full text articles published during 1991-2000.

**(B) Kisan Call Centres**

Toll Free Telephone No.—1800–180–1551. (Total Call Centres–144 at 28 locations) (w.e.f. 21 Feb., 2004)

**(C) Krishi Darshan, New Delhi**

Toll Free No. 1800-11-1112

**(D) Consumer National Helpline No**—1800-11-4000

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